Educational Communications and Technology:
Issues and Innovations

Lucy Santos Green
Jennifer R. Banas
Ross A. Perkins *Editors*

The Flipped College Classroom

Conceptualized and Re-Conceptualized

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Prologue: An Overview

Origin and Rationale of the Book

This text builds upon the research and ideas that we and a group of colleagues[1] presented at the 2014 Association for Educational Communications and Technology Conference, "The Flipped Classroom: Flop, Fiction, Fabulous or Frightening?" We conceived of this book as a way to provide higher education professionals with a solid foundation for developing flipped classrooms, using real-life cases from as many academic fields as possible. We scaffold the instructional considerations, including the organization of curriculum, design of learning activities and assessments in and outside the classroom, technology for course delivery and student learning, and both the accommodations and modifications developed to meet learners' needs. We also showcase how the flipped classroom presents new opportunities for enhanced instruction that deepens critical thinking and creativity including authentic, discovery, and problem-based learning; team-driven collaboration; in-time assessment and real-time feedback; and personalized learning experiences.

Flipping a classroom, as can be seen throughout this text, is not limited to doing simply one thing—it represents an ecosystem of technological and pedagogical influences that are all focused around the ultimate goal of helping students learn at a deeper level and, at the same time, emboldening instructors to engage with learners in a way that can be professionally very gratifying. There is no question that it is a challenge for all involved, but those represented in this text would undoubtedly submit that meeting the challenge of flipping the class brings about positive change.

The ecosystem of the flipped classroom can integrate different approaches such as distributed practice testing (Talley & Scherer, 2013), application of knowledge to new settings (Enfield, 2013), case-based learning (Boucher, Robertson, Wainner, &

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Sanders, 2013), and in-depth reflection models (Lasry, Dugdale, & Charles, 2014). Common themes in descriptions of flipped classes contain examples of recommended pedagogical practice. For example, video lectures should contain interactive components: note-taking devices, guided practice, or video responses (Enfield, 2013; Lasry et al., 2014; Pierce & Fox, 2012). Students should be able to share questions and identify areas of struggle so the instructor can address these during class. In-class activities should be student-centered, encourage in-depth exploration of content, and allow for application of knowledge to new settings (Butt, 2014). Finally, the process of independent student learning should be adequately scaffolded (Flumerfelt & Green, 2013; Talley & Scherer, 2013).

We hold that flipping a class is a worthwhile approach for all subjects, but especially those that contain material or processes traditionally difficult for students to grasp. Instructors who implement flipped methods can cover a broader topic list, introduce students to complex material, and deliver hands-on, guided inquiry learning experiences. Thus far, research indicates greater student mastery of content as demonstrated in course assessments (Boucher et al., 2013; Enfield, 2013; Lasry et al., 2014). It must be made clear, however, that there is a paucity of research on flipping in the tertiary education context. While some studies have been done and others are on-going, we strongly encourage those reading this text to consider how flipped instruction impacts student learning in both the near and far term.

The Structure of the Text

Part I, Chapters "The Flipped Classroom: A Brief, Brief History," "Step by Step, Slowly I Flip," "Tools of the Trade: What Do You Need to Flip?," and "Considerations When Evaluating: The Classroom Flip Instructional Technique," establishes a foundation for flipped instruction. In the Chapter "The Flipped Classroom, A Brief, Brief History," Edward Bates examines a chronological perspective on the pedagogical practice of "flipping" a class, reminding all that this practice existed many years before it was named. Bates also discusses the variations one sees of flipped class models. He concludes by addressing some common concerns instructors have with respect to the flipped classroom. In the Chapter "Step by Step, Slowly I Flip," Betina Hsieh covers the incremental steps of flipping an existing course. She also provides direction on how to create a new flipped course. In the Chapter "Tools of the Trade: What Do You Need to Flip?," Steven Crawford and Jinnette Senecal answer one of the big questions that instructors new to flipping content often have: "What do I use to do this?" Though technologies are forever evolving, these authors cover the "tools of the trade" and guide readers in deciding which tool characteristics are best, be these low or high tech. Finally, because we sincerely believe that any course design should have a strong formative evaluation piece, Sarah Zappe and Thomas Litzinger, authors of the Chapter "Considerations When Evaluating: The Classroom Flip Instructional Technique," discuss evaluating the impact that flipping has on teaching and student learning. Appropriately, they provide readers

with an overview of a research-based approach to evaluation and describe what other sources of evidence might help one better understand the flipped classroom implementation. A final section, "Tips for Conducting Evaluation," is a concise summary of useful ideas and considerations, including ideas about making such research publishable.

Part II gives readers a glimpse into the flipped classrooms of people teaching in many different disciplines; it is certainly not a technique limited to courses in one type of academic study. In this way, it is possible to either find a case study about a flipped classroom in a subject area similar to that which one teaches *or* find a flipping technique that resonates with the reader's style of teaching and level of technology proficiency. Case studies are all organized in the same way, which provides consistency and allows readers to quickly compare case elements should they so desire.

Each case study opens with the instructional context including a description of the course, the learning goals, and the learners. Case study authors then provide a rationale for flipping the classroom and identify the models, theories, and research that guided their flipping. Following the instructional context, case study authors describe the structure of the course and their method of implementation. This section includes descriptions about how they prepared their students for flipping, what in-class and out-of-class activities looked like, which tools they used to implement the course, and how they assessed student learning. Finally, in the last section, lessons learned, authors share their evaluation of the flipping experience from both the instructor and student perspectives.

The Theoretical Underpinnings of the Flipped Classroom

In our original conceptualization of the text, we set aside a chapter on the theoretical underpinnings of the flipped classroom. As the text evolved, we thought another approach might be more useful for our audience. Although examining theories in a single chapter can be helpful, it is perhaps more important for practitioners to consider theories in context. The discussion of theory and research is critical to validating the practices we present. Critical dialogue about these practices invites new ideas while challenging beliefs about the purpose and effectiveness of flipping.

In Part I, the authors consider theories in context through a descriptive, progressive narrative on the flipped classroom. For example, in the Chapter, "Step by Step, Slowly I Flip," Hsieh points out the need to consider cognitive load (Sweller, 1984) when making curricular decisions about what to include and what to leave out. She suggests a scaffolded approach to introduce complex topics, reminding of us Vygotsky's (1978) Zone of Proximal Development. To design and sequence instruction, she references well-recognized instructional design models including Gagné, Briggs and Wager's (1992) nine events of instruction. Building off of the Chapter "Step by Step, Slowly I Flip," Crawford and Senecal, in the Chapter "Tools of the Trade: What Do You Need to Flip?," remind us to chunk content (Miller, 1956) into

manageable bites of information, using both low and high-tech tools. Though the Chapter "Considerations When Evaluating: The Classroom Flip Instructional Technique" does not describe the theories on which to base instructional decisions, Zappe and Litzinger give a number of useful references for how to craft and implement evaluations (e.g., Kirkpatrick and Kirkpatrick, 2006), and also refer to various empirical studies, including those in which they have participated, that serve as models for evaluating the flipped classroom design (e.g., Bishop & Verlerger, 2013; Leicht, Zappe, Messner, & Litzinger, 2012).

Part II further enriches the discussion begun in Part I with flipped classroom case studies of instructors whose course content ranges from the humanities, to education, science, engineering, math, computing, health, music, and more. Each case study incorporates theory and research in both unique and reinforcing ways.

In the Chapter "Flipping the Humanities," case study authors Jennifer Black and Stephanie Cox indicate their course design was influenced by Paulo Freire's (2000) concept of problem-posing teaching. Kevin Gannon praises the use of team-based learning (Michaelson, Parmelee, McMahon, & Levine, 2008) as a means to shift from merely providing content in a lecture-oriented classroom to designing and managing a lab or workshop setting.

In the Chapter "Flipping Education," Xornam Apedoe uses the pre-training principle (Mayer, 2005) when flipping Educational Psychology to help reduce the cognitive overload that may be experienced by learners processing complex information. Sherry Long differentiates the student flipped learning experience in an Introduction to Education course by allowing students to demonstrate their understanding of course content in multimodal formats (Tomlinson, 2004). Jacqueline Morris and Ayles-Anne Wilson structure the entire Instructional Design for Teacher Education flip around the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, creating a group project that requires students to implement each step during in-class activities. Rebecca Morris assesses process not just product (Grennon Brooks and Brooks, 1993) when evaluating student learning in a constructivist approach to flipping Library Settings for Young People. Barbara Spector and Cyndy Leard also use constructivist theory to develop a flipped Science Methods course that enables rich student inquiry learning. Like Morris and Wilson, Jesse Strycker applies the ADDIE model to a Technology Integration course in a "constant cycle of design and evaluation [that] helped [the author] to introduce and scaffold students through each technology resource option."

In the Chapter "Flipping Engineering," case study authors Marnie Jamieson, John Shaw, and Norma Nocente also cite Vygotsky (1978), indicating his influence on their choice to use audio, visual, and print materials to scaffold instruction. Concepts from ADDIE and the Successive Approximation Model (Allen & Sites, 2012) were used to guide their development of content and selection of materials. Karim Altaii and Olga Pierrakos were inspired by cognitive apprenticeship theory, which posits "that students learn from experts by observation, imitation, and modeling. The instructor(s) serve as coaches to bring tacit processes out in the open." Jens Bennedsen

indicates that he is a constructivist. Citing Danish pedagogical professor, Steen Larsen (1999), Bennedsen claims that a person learns something if and only if:

1. You have to create something in a process.
2. You have to be emotionally involved in your creation.
3. This process requires skills that you almost meet.

As a consequence, Bennedsen structures learning so that work is based on individual competencies.

In the Chapter "Flipping STEM," Christensen, Tseng and Walsh find inspiration in Bruner's (1971) concept of discovery learning. Assignments in their flipped physics classroom are "structured to provide the preliminary knowledge necessary to complete tasks prior to class and then during class, students generate ideas, test solutions, and explain results individually and in groups." Lu, Szafron, Ahmed, Smith, and Onuczko incorporate not only constructivist principles in their flipped computer science course but also constructionist theories. Constructivism is a theory of learning where students actively construct knowledge as opposed to passive receiving of information (Ben-Ari, 2001; Machanick, 2007). While constructivism focuses primarily on cognitive aspects of learning, constructionism focuses on the learning that occurs when learners are engaged in "doing" and "building," which are actions well suited for the flipped classroom. Esteban Garcia, Iryna Ashby, and Marisa Exeter reference the tradition of apprenticeship and research that shows the value of project work as a means for "students [to] become aware of the iterative nature of design, and the (sometimes frustrating) nature of the creative process" (Cennamo & Brandt, 2012). Also guided by constructivist-inspired, active thinking, as described by Jonassen and Rohrer-Murphy (1999), Sun and Xie flip their math classroom so that they can move the lower cognitive level content (e.g., memorizing, understanding, and applying) to the pre-class work and maximize in-class time with active learning through collaborative activities and personalized instruction.

In the Chapter "Flipping the Health Sciences," Farris, Bowman, Demps, and Boyle remind us to think about preparing students to flip and the importance of considering self-regulated learning habits (Zimmerman, 1990). As a result, their flipped pharmacy therapeutics course orientations have included flipping the students' expectations of the traditional learning environment and setting realistic expectations about the preparation time required prior to face-to-face interactions. Janotha, like Black and Cox (Chapter "Flipping the Humanities"), applies team-based learning (TBL) pedagogy and its three stages (individual preparation assignments, learning assurance assessments, and team application activities; Michaelson, Parmelee, McMahon, & Levine, 2008) to the structure of the flipped course. Johnson and Galindo flip their medical science labs using elements of Allen's (2003) context, challenge, activity, and feedback (CCAF) matrix and Merrill's (2002) *First Principles of Instruction* (activation, demonstration, application, task/problem-centered, and integration). Finally, Vaughn, Hur, and Russell use Kolb's (1984) experiential learning model and social cognitive theory (Bandura, 1986) to develop exploratory in-class activities and collaborative projects in their kinesiology course.

In the Chapter "Flipping Other Areas," three case studies showcasing a flipped approach in three vastly different subject areas all emphasize a collaborative approach to problem solving. In a flipped course for Legal Research and Writing, Anne Alexander, like several of the case studies previously mentioned, operates in a constructivist, student-centered environment. In-class activities replicate the workings of an actual law firm. Grace Onodipe and Femi Ayadi use Gagne's nine events of instruction theory (Gagne, 1985) to design and develop collaborative out-of and in-class activities. Finally, River Lin concludes Part II with her description of group work for problem solving in a flipped Vocabulary Acquisition for ESL course.

We invite you, the reader, to delve into this text and join the conversation on flipped instruction. Our hope is not to convince anyone to "flip" a classroom, but rather to provide you with the information to make that decision for yourself as well as to support you with resources should you decide to modify a course (or courses) using a "flipped" approach. Ultimately, our goal for this collection of "flipped" writings, is for all using this text to find a chapter or case study that inspires them to do something very different than they have, perhaps, ever tried before.

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References

Allen, M., & Sites, R. (2012). *Leaving ADDIE for SAM: An agile model for developing the best learning experiences.* Alexandria, VA: American Society for Training and Development.

Allen, M. W. (2003). *Guide to e-learning: Building interactive, fun, and effective learning programs for any company*. Hoboken, NJ: John Wiley & Sons.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. New York: Prentice Hall.

Ben-Ari, M. (2001). Constructivism in computer science education. *Journal of Computers in Mathematics and Science Teaching, 20*(1), 45–73.

Boucher, B., Robertson, E., Wainner, R., & Sanders, B. (2013). "Flipping" Texas State University's physical therapist musculoskeletal curriculum: Implementation of a hybrid learning model. *Journal of Physical Therapy Education, 27*(3), 72–77.

Bruner, J. (1971). The process of education revisited. *The Phi Delta Kappan, 53*(1), 18–21. Social foundations of thought and action: A social cognitive theory. New York: Prentice Hall. Retrieved from http://www.jstor.org/stable/20373062

Butt, A. (2014). Student views on the use of a flipped classroom approach: Evidence from Australia. *Business Education & Accreditation, 6*(1), 33–43.

Enfield, J. (2013). Looking at the impact of the flipped classroom model of instruction on undergraduate multimedia students at CSUN. *TechTrends*, *57*(6), 14–27. http://doi.org/10.1007/s11528-013-0698-1

Flumerfelt, S., & Green, G. (2013). Using lean in the flipped classroom for at risk students. *Educational Technology & Society, 16*(1), 356–366.

Freire, P. (2000). *Pedagogy of the oppressed.* New York: Continuum.

Gagné, R. (1985). *The conditions of learning and the theory of instruction* (4th ed.), New York: Holt, Rinehart, and Winston.

Gagné, R. M., Briggs, L. J., & Wager, W. W. (1992). *Principles of instructional design* (4th ed.). Fort Worth, TX: Harcourt Brace Jovanovich College Publishers.

Grennon Brooks, J., & Brooks, M. G. (1993). *In search of understanding: The case for constructivist classrooms.* Alexandria, VA: ASCD.

Jonassen, D., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational Technology Research and Development, 47*(1), 61–79.

Kirkpatrick, D. L., & Kirkpatrick, J. L. (2006). *Evaluating training programs* (3rd ed.) San Francisco, CA: Barrett-Koehler Publishers.

Kolb, D. A. (1984). *Experiential Learning: Experience as the source of learning and development.* Upper Saddle River, NJ: Prentice-Hall Inc.

Larsen, S. (1999). *Den ultimative formel – for effektive læreprocesse.* Hellerup: Steen Larsens Forlag.

Lasry, N., Dugdale, M., & Charles, E. (2014). Just in time to flip your classroom. *The Physics Teacher, 52*(1), 34–37.

Machanick, P. (2007). A social construction approach to computer science education. *Computer Science Education, 17*(1), 1–20.

Mayer, R. E. (2005). Principles for managing essential processing in multimedia learning: Segmenting, pre-training, and modality principles. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning*. (pp. 169–182). New York: Cambridge University Press.

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development, 50*(3), 43–59.

Michaelsen, L., Knight, A., & Fink, L. (Eds.). (2004). *Team-based learning: A transformative use of small groups in college teaching*. Sterling, VA: Stylus Pub.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *The Psychological Review, 63*(2), 81–97.

Pierce, R., & Fox, J. (2012). Vodcasts and active-learning exercises in a “flipped classroom” model of a renal pharmacotherapy module. *American Journal of Pharmaceutical Education*, *76*(10), 196. http://doi.org/10.5688/ajpe7610196

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction, 4*, 295–312.

Talley, C. P., & Scherer, S. (2013). The enhanced flipped classroom: Increasing academic performance with student-recorded lectures and practice testing in a "flipped" STEM course. *The Journal of Negro Education, 82*(3), 339–347. http://doi.org/10.7709/jnegroeducation.82.3.0339

Tomlinson, C. (2004). *The differentiated classroom: Responding to the needs of all learners*. Alexandria, VA: ASCD.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25*(1), 3–17.

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Part I
The Flipped College Classroom: An Overview

The Flipped Classroom: A Brief, Brief History

J. Edward Bates, Hasan Almekdash, and Maggie J. Gilchrest-Dunnam

Abstract This chapter uses a chronological perspective to examine the pedagogical practice of "flipping" a class, reminding all that this practice existed many years before it was named. The chapter also discusses the variations one sees of flipped class models. It concludes by addressing some common concerns instructors have with respect to the flipped classroom.

Introduction

The flipped classroom approach has been used for years in various disciplines of higher education (Brame, 2013), although recent efforts to define and promote the practice have led to increased awareness and dedicated research. The flipped classroom approach does not comprise a single model, but rather a core idea to flip the lecture-based classroom instruction and utilize prerecorded videos and reading assignments in advance of class (Tucker, 2012). Class time is then used to engage learners in problem-based, collaborative learning and advancing concepts. Most importantly, the learner has control of the pace and time it takes to learn the material. This chapter provides a detailed review of the events leading to the creation of the term "flipped classroom," the methodologies that influenced its formation, and the current discussion regarding institutional and faculty concerns, as well as its utility.

Antecedents

Educators who believe in social, student-centered, collaborative, and cooperative learning that engages learners as an active and responsible part of the educational process have always practiced educational methods similar to what is known today

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as the flipped classroom. A good example that supports this claim is the Socratic dialogue approach in ancient Greece where learners, by themselves, engaged in real-life challenges and activities, sharing their own thoughts in opinions in order to find solutions to problems (Berge, 1995). Under classical idealism as an educational philosophy, the Socratic method suggested one of the earliest models of a student-centered approach (Ebert & Culyer, 2007). Socrates believed, and principles of idealism assert, that knowledge and truth have always existed in the human mind. Knowledge itself cannot be created. In other words, the learner's role in education is to discover, rather than to create truth and knowledge (Ebert & Culyer). In the Socratic method, also known as *maieutic* (Ebert & Culyer), the role of the teacher is similar to a midwife: helping learners give birth to the knowledge and truth they discover through the processes of debating and questioning what they know and what they do not know. In this teaching approach, the teacher spends more time observing and guiding learners they progress through the educational process.

After Socrates, Aristotle and classical realism dominated educational approaches. Unlike idealism, realism claimed that truth and knowledge existed not only in the human mind, but also in the physical world (Ebert & Culyer, 2007). The role of learners was to measure and to observe truth in the real world. Even though realism placed great importance on the role of the teacher as the source of knowledge, the learners, through experimental learning, had a positive and active role in the educational process.

Advocates of educational philosophies that emerged in the beginning of the twentieth century, such as progressivism and reconstructionalism, pinpointed the importance of a student-centered approach in which learners are engaged in finding answers and solutions to real-life problems and challenges (Eisner & Freeman, 2013). Pragmatism, from which progressivism and reconstructionalism were derived (Eisner & Freeman, 2013), was implemented by the ideas of John Dewey in the first half of the twentieth century (Ebert & Culyer, 2007). Dewey's philosophies suggested that knowledge can be achieved through challenging learners' minds in order to solve real-life problems. This approach implied a greater role of learners in the educational process: learners were responsible for discovering and creating knowledge. The philosophies that support student-centered educational approaches stand on the argument that the learners' role is to synthesize, discover, and create knowledge. Knowledge is not something that is dictated by the all-knowing instructor but rather what learners uncover and develop. The role of the teacher in student-centered philosophies is to organize, guide, and help learners make sense of the results of the educational process. These educational philosophies may speak to the effectiveness of the flipped class room, even before it was practiced the way we know it nowadays, inasmuch as the flipped classroom carries in its very essence what these philosophies tried to achieve in education.

Naming the Practice

For many, the flipped classroom approach will seem familiar to teaching methods used for many years: review of the lecture and text material prior to class, with class time spent on developing concepts and collaborative, active learning. Previous

models that incorporate similar methods include peer instruction, inverted classroom, and even a method introduced as the classroom flip in the year 2000 by Dr. J. Wesley Baker (Baker, 2000; Brame, 2013; Crouch, Watkins, Fagen, & Mazur, 2007; Lage, Platt, & Treglia, 2000). The primary difference that enabled the flipped classroom concept to flourish is the utilization of easily accessible digital and online media.

The current approach to the flipped classroom is commonly attributed to two high school teachers in Colorado, Jonathan Bergmann and Aaron Sams (Bergmann et al., 2011; Tucker, 2012). To accommodate students who missed classes, they used basic video recording software that added voice-over and annotation of PowerPoint slideshow presentations accessed through electronic and online media. Bergmann and Sams first called the method the pre-vodcasting model: "pre" to address the concept that viewing of the video occurred prior to class and 'vodcasting' as an acronym for video podcasting. After developing and providing professional development to other teachers, they changed the name to *reverse instruction* to address the fear teachers expressed with the technology-driven name. A 2010 article appearing in *The Telegraph* (United Kingdom) attributing Bergmann and Sams' concepts to Karl Fisch, a high school teacher in Denver who had blogged about the "flipped classroom" model (Pink, 2010). As the term became popular both domestically and abroad, Bergmann and Sams used the flipped classroom name, culminating in the publication of a book in 2012, *Flip Your Classroom: Reach Every Student in Every Class Every Day.*

In the years since its inception, Bergmann and Sams continue to deliver professional development on the flipped classroom methodology through consultative services, annual conferences, and coordination of a national dialogue through the *Flipped Learning Network*. The credibility of the flipped classroom methodology has been further expanded by the creation and expansion of additional resources specifically geared toward flipped learning: Khan Academy, Coursera, TED-ED, and other massive open online courses providers (Johnson n.d.). Within higher education, the terminology used for the practice still varies between blended learning, inverted classroom, and flipped learning; but the call for course redesign to model the principles of the flipped classroom continues to be made throughout the literature and through professional organizations (Aronson & Arfstrom, 2013; Herreid & Schiller, 2013).

Modern Student-Centered Educational Approaches: Application and Practices

Student-centered educational approaches are widely practiced in education, a result of empirical evidence proving these are much more effective than the traditional teacher centered instructional approaches, in which students are passive participants in the educational process. Modern educators, who believe in social collaborative and corporative teaching methods (inverted classroom, peer instruction, and reversed learning), often apply the flipped classroom, as a student-centered educational approach (Bishop & Verleger, 2013).

Assignment-Based Model

Walvoord and Anderson (1998) proposed one of the most successful implementations of the flipped classroom in the humanities. The assignment-based model they designed asks that learners participate in productive writing and problem solving activities before class. In class, students engage in processing activities concluding with productive feedback (Brame, 2013). The Walvoord and Alderson model is effective because learners receive their first learning exposure before class, while they work on the processing aspect of learning, including the critical thinking processes of analyzing, problem solving, synthesizing, during class. This model was also reported to be highly effective in reducing the instructor's written feedback.

The Inverted Classroom

In their introductory economics class, in the year 2000, Lage and Platt, found the traditional lecture to be ineffective and implemented the inverted classroom structure (Brame, 2013). They provided a variety of materials such as reading selections, videos, PowerPoint slides with audio recordings, and printable PowerPoint slides that learners reviewed and used to complete small assignments. During class time, students engaged in discussing the given materials in groups, applied the principals they learned, responded to each other's questions, and presented information in a mini lecture format. Learners and instructors found this method very motivating and more effective in achieving the course learning outcomes.

Peer Instruction

Eric Muzar, a Harvard Physics professor, noticed that students' learning, problem solving, and reasoning skills improved when they interacted with each other, and when he coached rather than lectured. He began using a form of inverted classroom—peer instruction. Before peer instruction occurs in class, learners are first exposed to new material, completing knowledge check assignments and quizzes before class to ensure they are prepared (Brame, 2013). In addition to condensed (mini) student lectures and other student-centered learning activities, peer instruction involves answering conceptual questions (Crouch et al., 2007). In Muzar's course, these conceptual questions were first anonymously answered by all students in class. He then displayed the percentage of correct and wrong answers. If he saw that there were a significant number of incorrect answers, then he directed learners to reengage in group discussions while the Muzar walked around, stimulating further student interactions.

Mazur's peer instruction method can be considered one of the early practices of the modern flipped classroom in that students are responsible for initial interaction with, and understanding of course content (Crouch et al., 2007). Muzar's experience was further confirmed by Hake (1998). In a large-scale study, Hake compared data

collected from two groups of Physics students; one taught using traditional teaching methods and another taught through peer instruction. He found that of the 4458 students enrolled in over 48 courses, students who received personalized instruction showed greater gains ($<g> = 0.48 \pm 0.14$) than those who received traditional instruction ($<g> = 0.25 \pm 0.04$) (Hake, 1998).

Why Are We Talking About This Now?

Mukerjee argues "the digital world is driving innovation and continuous change at such a rapid and random rate that universities are struggling to keep up with demand" (Mukerjee 2014, p. 56). Students of this generation and future generations have greater access to information. Prensky (2005) believes that because these students have had the greatest access to information and social media connection than other previous generation, they expect constant communication in all aspects of their lives, including education. In fact, Vaughan (2014) argues that millennial learners have the greatest ease of access and prefer to learn in active and collaborative environments. Knowing the preferences of current students with respect to communication, access, and collaborative learning, the flipped classroom is a relevant topic for higher education.

Institutional Concerns

Some institutional personnel are skeptical about the use of the flipped classroom, citing concerns about students' access to technology to watch prerecorded lectures, especially for students from low socioeconomic backgrounds. One should always be cognizant of potential difficulties faced by student access to Web-based resources regardless of background. However, recent reports show that there are in fact few differences between socioeconomic groups in terms of access to the Internet (Perrin, 2015; Smith, 2011).

Another concern regarding the flipped classroom has to do with student motivation. While many educators agree that flipped classrooms allow for a self-paced learning experience, educators who use a flipped classroom have to assume that students who are less motivated will struggle in that setting. Arguably, students who are less motivated are likely to struggle and procrastinate in traditional classroom settings as well. It should be noted that institutions that are resistant to flipped classroom models and other similar styles of education on the basis that students may not be motivated enough to be successful, may be perpetuating an anti-autonomous attitude for the student. Indeed, the idea behind student-centered learning is not just to meet the students where they are in terms of understanding, but also to provide an opportunity for the student to build confidence in their education based on their ability to be responsible and autonomous for the information/learning they are seeking.

As colleges and universities try to expand their reach to distributed students through online programs and e-learning environments, the flipped classroom has gained ground as a hybrid form of online learning (Horn, 2013). Students who have Internet access are able to watch videos uploaded by professors and listen to podcasts via their mobile

devices. Therefore, classroom spaces and teaching resources become more efficient. Tuition at most universities continues to rise, however creating a flipped classroom requires little to no additional infrastructure cost, allowing universities to allocate funds elsewhere. Further, incorporating a flipped classroom model may help to manage large course offerings preserving faculty research time (Hutchings et al., 2013).

Faculty Concerns

Faculty concerns generally revolve around the time and effort that must be exerted to redesign an existing course, obtain student buy-in, and the prevalence of student evaluations being tied to faculty tenure and promotion (Aronson & Arfstrom, 2013). The work required upfront is often cited as a barrier to implementation, though when undertaken by department faculty together, these pressures are somewhat alleviated. As described in several of the case studies in the second half of this text, student buy-in needs to be directly addressed. In a University of Queensland study on flipped learning, one professor noted, "The flipped classroom received a lot of resistance upfront. What the students did not say directly, but something to which they were alluding, was that they had to learn at the rate which the classroom was going rather than 'letting it slide' and cramming at the last moment" (Aronson & Arfstrom, 2013). It would seem counterintuitive to use students' procrastination as a reason to avoid implementing a teaching approach. Finally, Mazur claims that student satisfaction is not the point if students are more engaged and are performing at a higher level (Brame, 2013). The reality is that different students have different preferences and some will tend to favor the flipped model while others will not. As students and faculty become more experienced with the approach, it is likely that opposition will decrease (Aronson & Arfstrom, 2013).

Conclusion

Flipped classrooms allow for transformative, student-centered learning (Hutchings et al., 2013). Traditional classroom learning tends to rely on the delivery of a lecture, where students listen passively to the required material. In a flipped classroom, students can be more active and collaborative in their learning through application and evaluation activities during class time, activities that foster critical thinking and creativity (Mazur, 2009; Wallace, Walker, Braseby, & Sweet, 2014; Westermann, 2014). Because the premise of a flipped classroom is for hands-on activities, like problem-solving homework to be completed in class, and with the professor and peers there to assist in learning, students feel free to become more engaged and active in their educational journey. With students actively seeking learning through online and digital media and as higher education institutions increasingly invest in information technology infrastructure and digital landscapes, the environment is increasingly suited for the flipped classroom model. The various approaches successfully implemented prior to the flipped classroom model and the availability of video recording software and digital instructional resources create ample opportunities for its application across all disciplines in higher education.

Discussion Questions

1. What additional apprehensions would faculty have regarding student-centered, active learning teaching methods?
2. In an ever more digital world, what is preventing widespread institutional support for technologically supported teaching?
3. Are there academic disciplines that would not benefit from the flipped learning approach (i.e., law, health professions, social sciences)?

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References

Aronson, N., & Arfstrom, K. M. (2013). *Flipped learning in higher education*. Retrieved from http://www.flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/41/HigherEdWhitePaper%20FINAL.pdf.

Baker, J. W. (2000). The "Classroom Flip": Using web course management tools to become the guide by the side. *Selected Papers from the 11th International Conference on College Teaching and Learning* (pp. 9–17).

Berge, Z. (1995, April 1). Computer-mediated communication and the online classroom in distance learning. *Computer-Mediated Communication Magazine*, *2*(4), 6.

Bergmann, J., Overmyer, J., & Willie, B. (2011). The flipped class: What it is and what it is not. The Daily Riff, Retrieved from http://www.thedailyriff.com/articles/the-flipped-class-conversation-689.php.

Bishop, J., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. Paper presented at 2013 ASEE Annual Conference, Atlanta, Georgia. https://peer.asee.org/22585.

Brame, C. (2013). *Flipping the classroom*. Retrieved June 18, 2015, from http://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom/.

Crouch, C. H., Watkins, J., Fagen, A. P., & Mazur, E. (2007). Peer instruction: Engaging students one-on-one, all at once. *Research-Based Reform of University Physics, 1*(1), 40–95.

Ebert, E. S., & Culyer, R. C. (2007). *School: An introduction to education*. Belmont, OH: Thomson Wadsworth.

Eisner, E. W., & Freeman, S. (2013). Notes on composing and composition. *Curriculum & Teaching Dialogue, 15*(1/2), 1–9.

FlippedClass.com. (2011, May 6). *The history of the flipped class.* Retrieved from http://flippedclass.com/the-history-of-the-flipped-class/

Hake, R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics, 66*, 64–74.

Herreid, C. F., & Schiller, N. A. (2013). Case studies and the flipped classroom. *Journal of College Science Teaching, 42*(5), 62–66.

Horn, A. H. (2013). *Education engine - degrees and education that drive your career*. Retrieved from http://www.educationengine.com/articles/article9.

Hutchings, M., Quinney, A., Galvin, K., & Clark, V. (2013). The yin/yang of innovative technology enhanced assessment for promoting student learning. In S. Greener (Ed.), *Cased studies in e-learning research for researchers, teachers, and students* (pp. 62–79). Reading, MA: Academic Publishing International.

K. Johnson. (n.d.). *TED-ED, Khan Academy enable flipped classrooms.* Retrieved June 18, 2015, from http://www.wired.com/2012/03/flipped-classrooms/

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education, 31*(1), 30–43.

Mazur, E. (2009). Farewell, lecture? *Science, 323*(5910), 50–51.

Mukerjee, S. (2014). Agility: A crucial capability for universities in times of disruptive change and innovation. *Australian Universities' Review, 56*(1), 56–60. Retrieved from https://www.learntechlib.org/p/154480.

Perrin, A. (2015). *Social networking usage: 2005–2015*. Washington, DC: Pew Research Center. Retrieved from http://www.pewinternet.org/2015/10/08/2015/Social-Networking-Usage-2005-2015/.

Pink, D. (2010). Think Tank: Flip-thinking - the new buzz word sweeping the US. The Telegraph. Retrieved from http://www.telegraph.co.uk/finance/businessclub/7996379/Daniel-Pinks-Think-Tank-Flip-thinking-the-new-buzz-word-sweeping-the-US.html.

Prensky, M. (2001a, September/October). Digital natives, digital immigrants. *On the Horizon, 9*(5), 1–6. Retrieved April 30, 2003, from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf

Prensky, M. (2001b, November/December). Digital natives, digital immigrants, part II: Do they really think differently? *On the Horizon, 9*(6), 1–6. Retrieved April 30, 2003, from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part2.pdf

Prensky, M. (2005). Listening to the natives. *Educational leadership, 63*(4), 8–13. Retrieved from http://www.ascd.org/ASCD/pdf/journals/ed_lead/el200512_prensky.pdf.

Smith, A. (2011, November 14). *Why Americans use social media: Social networking sites are appealing as a way to maintain contact with close ties and reconnect with old friends.* Retrieved from http://www.pewinternet.org/files/old-media/Files/Reports/2011/Why%20Americans%20Use%20Social%20Media.pdf

Tucker, B. (2012). The flipped classroom: Online instruction at home frees class time for learning. *Education Next, 12*(1), 82–83.

Vaughan, M. (2014). Flipping the learning: An investigation into the use of the flipped classroom model in an introductory teaching course. *Education Research and Perspectives, 41*, 25–41.

Wallace, M. L., Walker, J. D., Braseby, A. M., & Sweet, M. S. (2014). Now what happens during class? Using team-based learning to optimize the role of expertise within the flipped classroom. *Journal on Excellence in College Teaching, 25*(3&4), 253–273.

Walvoord, B. E., & Anderson, V. J. (1998). *Effective grading: A tool for learning and assessment*. San Francisco, CA: Jossey-Bass.

Westermann, E. B. (2014). A half-flipped classroom or an alternative approach?: Primary sources and blended learning. *Educational Research Quarterly, 38*(2), 43–57.

Step by Step, Slowly I Flip

Betina Hsieh

Abstract This chapter covers the incremental steps of flipping an existing course. It provides direction on how to create a new flipped course, emphasizing the need to consider cognitive load when making curricular decisions about what to include and what to leave out. To design and sequence instruction, the chapter references well-recognized instructional design models including Gagné, Briggs, and Wager's nine events of instruction.

While the idea of flipping may be both convincing and exciting, the process of actually designing a course that implements flipped classroom pedagogies and practices seems mysterious or overwhelming. This chapter begins with an introduction to curricular design principles important to a flipped setting. It continues with a discussion on flipped modules within a traditional course, fully flipping a new or existing course, and how various pedagogical tools fit into a flipped model. Finally, the chapter concludes with reflections on the flipped mindset and how we can promote success in our flipped classrooms.

A Quick Introduction to Curricular Design Principles

Although the focus of this book as a whole is on the flipped classroom, we begin with a review of key principles related to course design prior to setting the stage for adapting a strong, traditional course for a flipped environment. Whether our instructional practice is based on behaviorist, cognitivist, or constructivist theories, strong classrooms integrate instructional design principles consistent with each of these major learning theories. I have developed a breakdown of three key design principle

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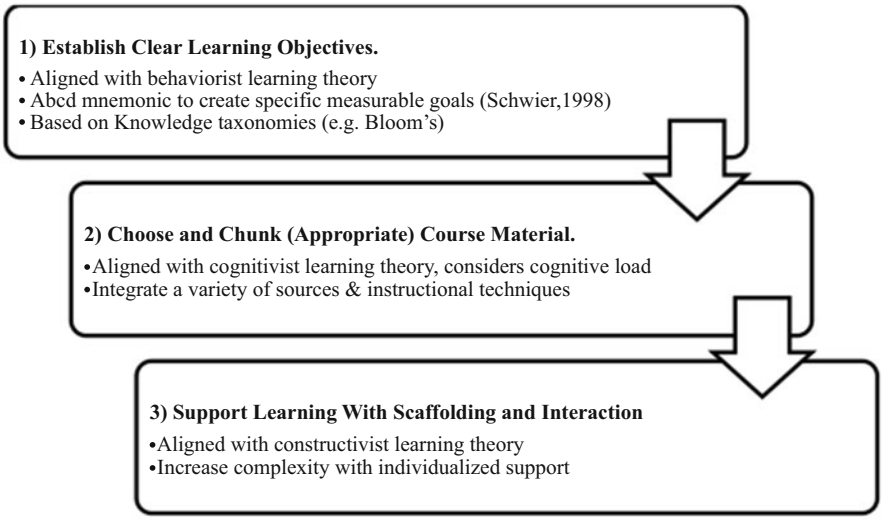

Fig. 1 Three key instructional design principles

stages for successful classroom instruction based upon a synthesis of the curricular design literature discussed in depth below (see Fig. 1). The three steps to this breakdown are: (1) Establish clear learning objectives; (2) Choose and chunk (appropriate) course material; and (3) Support learning with scaffolding and interaction.

Establish Clear Learning Objectives

Establishing clear learning objectives for students is a design principle aligned with behaviorist learning theory that supports strong instruction. The "abcd" mnemonic (Schwier, 1998), specifying the: (a)udience, desire (b)ehavior, (c)ondition, and (d)egree within each objective promotes clear expectations for student learning. A traditional example of this might be: "Following instruction, 100% of students will be able to explain the five functions of a classroom setting given a written prompt." This objective is geared towards students (audience), who will explain the five functions of a classroom setting (behavior), following instruction (condition). The expectation is that 100% of students in the class (degree) will be able to achieve this objective as assessed by the writing prompt, a specific measureable task. Objectives such as these are important to guiding the learning process for students and keeping the course on track.

Clear learning objectives may reflect varying levels of behaviors according to learning taxonomies like Bloom's cognitive taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). However, regardless of level, objectives support students understanding of what they are to complete and know prior to class and why that knowledge is important. To this end, objectives should be shared with students and reinforced throughout instruction (i.e., introduced at the beginning of a session,

restated specifically before a particular section of lecture or activity and revisited at the end of class). These objectives support our work as instructors, in planning instruction that is appropriate and focused.

Choose and Chunk (Appropriate) Content Material

Chunking content and course material is a design principle aligned with the information-processing aspect of cognitive learning theory, cognitive load. Cognitive load refers to the burden placed on the working memory during instruction as it works to acquire knowledge, automate processes, and/or move information into long-term memory (Sweller, 1994). Cognitive load can be reduced when instructors connect new learning to prior learning, building upon student schema (previous knowledge) to develop new concepts (Sweller, 1994; Vygotsky, 1978). Cognitive load reduction can also be supported through chunking material or breaking it down into smaller units for processing (Banas & Velez-Solic, 2013), allowing for more efficient processing by the working memory. In Fig. 2, I have illustrated the way in which I initially chunk a classroom management module from a preservice teacher education course that I teach. The larger concept (classroom management) is broken up into three weeks worth of lectures, each represented by the sub-topics.

Figure 3 illustrates the second level of chunking that occurs at the individual lecture level for week two of the original model, "Creating an Environment for Teaching and Learning":

Chunking occurs in two stages: the overall module (larger concept) broken down into discrete lectures; and the individual lecture broken down into smaller manageable components of instruction. We can also see the connections to and construction of schema using these figures. "Creating an Environment for Teaching and Learning" (lecture #two) builds upon "Creating a Community of Learners" (lecture #one) by discussing how the physical classroom environment promotes safety and security, social contact, and symbolic identification as well as how norms, expectations, procedures, and routines can support an academic community of learners. This lecture

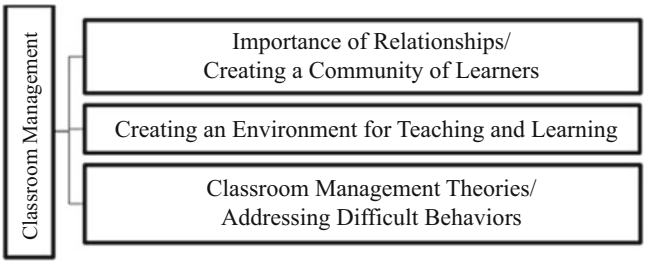

Fig. 2 Chunking an instructional module into discrete lectures

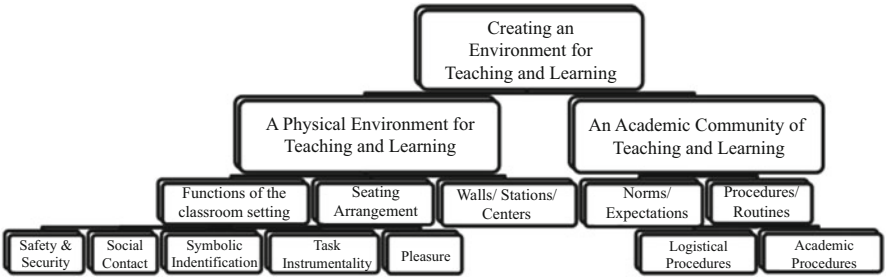

Fig. 3 Chunking a lecture into discrete components for instruction

also sets the stage for the lecture #three on "Classroom Management Theories/ Addressing Difficult Behaviors" by discussing the importance of setting up norms and expectations for students.

By breaking down larger concepts into individual lectures and lectures into smaller discrete components that allow students to process information in smaller chunks, we promote greater student retention of materials and greater student learning.

Support Learning with Scaffolding and Interaction

After establishing clear learning objectives and chunking material appropriately, it is important to provide multiple learning opportunities that move from simple to more complex as these build upon student schema (Vygotsky, 1978), a practice consistent with cognitivist and constructivist learning theory. This is often where we can feel pressured in a traditional classroom when it comes to time. As evidenced by Fig. 3 above, a single lecture may be broken down into numerous smaller components to reduce cognitive load and better allow for student processing. However, chunking without integrating interaction and opportunities to deepen understanding through multiple exposures to material that move from simpler to more complex leaves many students without integral supports for their learning. Difficulties arise in many conceptually challenging courses when we are caught between covering a large amount of content and covering it in ways that support effective student learning, especially given the limited amount of time that we have with students. This is where flipping comes in.

Instruction and Flipped Instruction

Principles central to strong curricular design apply to the flipped classroom as well as traditional instruction; but, flipped classrooms add an extra instructional phase to account for the design process. In its most basic form, flipped instruction is distinct from traditional instruction in that content materials are assigned for students to

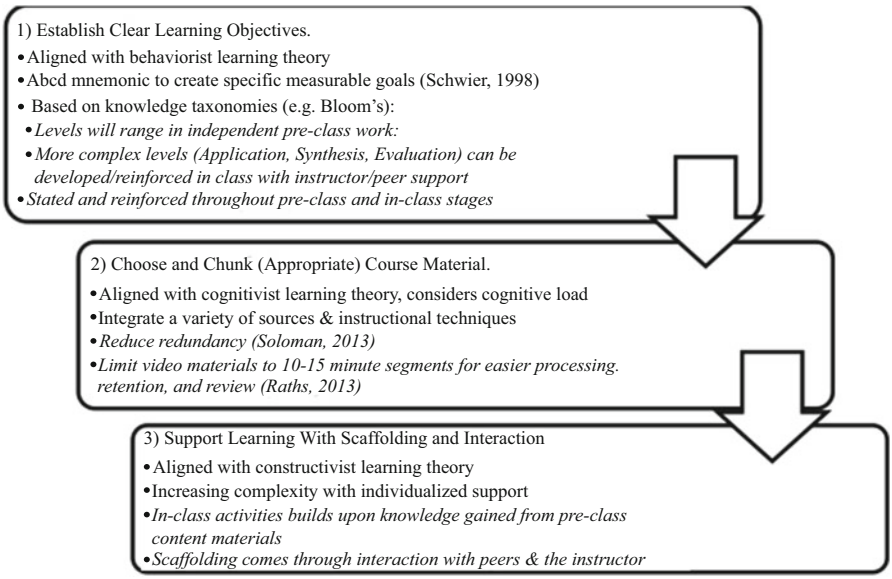

Fig. 4 Design principles of a flipped classroom

complete independently, outside of class, while class time is used to begin or complete assignments (with peer and instructor feedback), engage in hands-on activities, or work in collaborative groups (Bergmann & Sams, 2012; Garrow, Hotle, & Mumbower, 2013). However, successful flipped classrooms involve much more than moving lecture and content outside of the classroom. Below (Fig. 4) is a revised version of Fig. 1 that modifies the three essential principles listed above for a flipped classroom setting (additions in italics).

In this section, we explore exactly what changes in each aspect of the curricular design process when flipping instruction and how this benefits instructional practice and student learning.

Clear Learning Objectives: The Importance of Communication in the Flipped Classroom

In the flipped classroom, because of the two explicit phases of instruction, students must know what is to be accomplished before, during, and after class and have regular assessments to measure their progress and understanding. For example, prior to coming to class, you might have students watch a recorded lecture with the learning objective: "Following the recorded lecture, students will be able to answer with 90 % accuracy the questions on the classroom environment quiz." This example is a knowledge or comprehension-based objective (i.e., the lower levels of Bloom's

taxonomy), which is appropriate when pre-class materials are intended to introduce students to a given topic that will be elaborated upon in class. It still adheres to the "abcd" mnemonic, but guides students learning in the pre-class session. In the flipped model, because the quiz (assessment) would be completed prior to class, in order to ensure that students have the prerequisite knowledge to participate in class activities, instructors also must have clearly communicated learning objectives for this segment of the course.

The subsequent in-class objective might be: "By completing in-class activities, students will be able to apply classroom environment principles to design a classroom that aligns with all five functions of the classroom setting and their professional identities as evaluated by a grading rubric" The in-class objective requires prerequisite knowledge as well as application, synthesis and creation in the design of a classroom environment considering specific traits. These higher levels on Bloom's taxonomy demonstrate the increasing demand in relation to knowledge for students. The "abcd" mnemonic still proves a useful framework for designing clear objectives, but objectives are expanded to include both pre-class and in-class phases of instruction, allowing for greater depth of knowledge goals and multiple exposures to complex concepts (Fig. 5).

Given the phases of instruction in the flipped model, objectives must be reinforced more often for students as well. Whereas in the traditional classroom, objectives might be shared with students at the beginning of lecture, before any activities that take place, and revisited or assessed at the end of lecture, in the flipped classroom, we might introduce objectives before students watch, read, or interact with the pre-class materials; again in the directions if they need to complete a task with the materials, and yet again in class at similar times to traditional instruction. Effective flipped classroom are based upon clear, consistent, and constant communication. Given the initial independent learning expectation, creating and consistently communicating

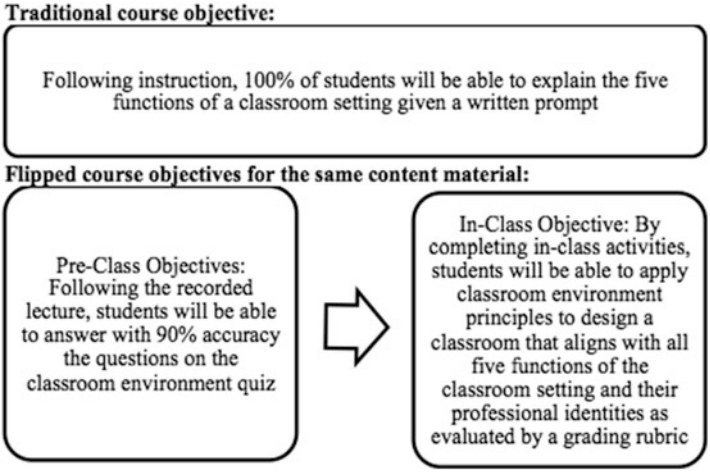

Fig. 5 Objectives models in traditional vs. flipped classroom

strong learning objectives throughout student learning phases is critical to facilitate the greater depth and feedback opportunities enabled by the flipped classroom.

Content Material and Chunking: Developing Understanding at a Distance and In-Person

Cognitive load issues can be complex in thinking about the flipped classroom, particularly as it relates to technology integration. Previous work on multimedia and online learning has noted that a learner's familiarity with the medium of instruction can often impact his or her experience of cognitive load (Banas & Velez-Solic, 2013). Initially, the flipped classroom may increase our cognitive load as well as that of our students. The introduction of lecture materials prior to instruction, particularly when integrating twenty-first century learning tools and materials, can initially be taxing for instructors and students not familiar with electronic learning environments. Because students also first access content material outside of class, we must design and format materials that engage students and are appropriate, given students' independent processing capacity and familiarity with the tools of instruction for pre-class learning. If this is done well, while there might be an initial increase in cognitive load related to technology integration, the eventual goal of flipped instruction would be to reduce cognitive load for students by chunking material into the pre-class and in-class phases of instruction. By more effectively chunking material, instructors who stay true to the flipped model can eliminate much if not all lecture time in class, using valuable face-to-face instructional time to develop understanding at more complex levels.

Once we overcome the cognitive load demands that come with integrating technology, the pay-off is not only a reduction of cognitive load for students, but also an increase in opportunities for learning. In addition to chunking content through two phases (pre-class and in-class instruction) to reduce cognitive load on students' working memory, flipped classrooms also are often more able to integrate various sources of information; present information using multiple instructional techniques; and reduce redundancy. By adding short podcasts (audio recordings), video-recorded lectures, and/or relevant instructional videos, we can reduce cognitive load for greater numbers of students by considering modes of processing. Combining visual and auditory instruction can be used to support students' short-term memory retention in a similar way. Reducing redundancy in material also frees the working memory load associated with processing repetitive information (Soloman, 2013).

As we consider flipping instruction in relation to content, it is important not only to keep in mind the format of any lecture-based materials posted for students, but also the length of such materials. Ideally, lecture videos and audio-recordings should not be longer than 10–15 min and should be clearly connected to the objectives and assessments for instruction (Raths, 2013). This does not limit you to 10–15 min per instructional session; but rather 10–15 min audio or video segments that can be watched or listened to separately, and in either a sequential or nonsequential way, thus greatly enhancing the use of chunking in instruction. Chunking in this way allows for

students to better process, retain, and review the information they are receiving. Chapter 3 "Tools of the Trade: What Do You Need to Flip?" will explain how to create these materials and further elaborate on the importance of chunking content and materials.

Supporting Learning with Scaffolding and Instruction: Using Pre-class and In-Class Time Effectively

As noted above, pre-class content should be in manageable chunks that allow students to avoid cognitive overload. It is also crucial that face-to-face instruction be broken down into comprehensible chunks, scaffolded to take place in students' Zone of Proximal Development, or the level of learning that they can access with expert support (Vygotsky, 1978). Scaffolding strategies might include providing students with graphic organizers, guiding prompts and instructor feedback both pre-class and in-class. Interaction between students, as another way to reduce cognitive load and promote student learning, can take place through think–pair–share activities, paired or group projects or presentations, or through peer response groups in-class. The flipped classroom facilitates using interaction as a learning scaffold by moving lecture prior to class and freeing face-to-face meeting time for structured interactive activities.

In the flipped classroom, when students come into class, they will have already engaged with the content, giving them schema upon which to build. The knowledge acquired through pre-class materials should be developed through activities that can range from simple guiding questions that connect the information presented to the objectives (e.g., in a short quiz, or with comprehension questions to complete for discussion) to more complex individual or group activities that require analysis, synthesis and evaluation. More complex activities will require more support that can be given in face-to-face meetings. The key to this design principle is that in-class should develop and deepen student understanding with opportunities for instructional strategies, peer interaction and/or instructor feedback.

Using the objectives above, students might watch a brief recorded lecture (and perhaps complete a reading) that previews the design principles of a classroom environment for teaching and learning. This pre-class lecture can include an overview of the five functions of the classroom setting and show students various classroom seating arrangements as well as other physical spaces in the classroom (e.g., stations, walls, and doors). The pre-class quiz might ask students to identify the functions of the classroom setting or respond to a short answer question asking them to discuss how a particular seating arrangement reflects these functions. The pre-class lecture would be a preview for the in-class activity of having students design their own physical classroom environments (on paper or in a 3D model) and write or orally explain the ways in which their created physical environments connected not only to the five functions of the classroom setting but also to their professional identities (discussed in a previous class session). Explanation could be done in groups so that students would

receive peer feedback on their presentations prior to submitting their designs for instructor evaluation. Working on the design process in class would also allow the instructor to formatively assess students, monitoring progress and giving feedback to groups. In this example, while the pre-class information introduced the conceptual knowledge of physical environment to students, the in-class activity allowed for more complex and nuanced application, synthesis, evaluation and creation supported by peers and the instructor. Table 1 gives a more general breakdown of the ways in which traditional and flipped classrooms might utilize scaffolding and interaction to support learning.

While the flipped classroom approach permits students to begin or complete assessments during class, instructors should avoid turning the classroom into a study hall. Indeed, the beauty of the flipped classroom is that it allows for greater guidance as students are completing more complex (and often more engaging, hands-on and inquiry-based) tasks that require higher levels of thinking. Rather than asking students to apply concepts independently after an in-class introduction, the flipped classrooms allows us to support students as they apply the concepts they have accessed independently in a more meaningful, structured and interactive classroom environment, as discussed in Table 1.

In this classroom design example, students benefit from peer collaboration, instructor feedback and an opportunity to have structured interaction with the rubric grading criteria during the in-class design of their classroom environment. They build upon their prior knowledge by using the functions of a classroom setting they learned about in pre-class lecture to help provide a lens through which to guide their creative process.

Starting Small: Flipping Individual Modules or Themes Within a Traditional Classroom

Now that we have discussed key design principles for the flipped classroom, how do we begin flipping one of our own courses? One recommendation made by veteran flippers (Raths, 2013) is to start small. Flipping a class can be a time intensive process at the start. In addition to the aforementioned potential cognitive load issues for instructors that arise with the integration of new technologies, instructors may need to find, record, and chunk appropriate lecture material, revise or add new in-class activities, and redesign the syllabus to reflect clear objectives that align with each part of the course (before class, in class, after class).

Beginning with a single module or section of a course, rather than flipping the entire course, allows instructors and their students to experience benefits of flipping without the intense time commitment required for full-scale implementation. It also allows each instructor to develop his or her own comfort and proficiency with the flipped design while determining some of the areas with which students may struggle (e.g., technology use, access to materials, completing before class assignments) before launching a full-scale flipped course. This section of the

Table 1 Instructional phases in traditional and flipped classrooms

Instructional phase	Traditional classroom instruction	Traditional classroom scaffolding/interaction/support	Flipped classroom instruction	Flipped classroom scaffolding/interaction/support
Before class	Assigned readings	None/minimal	Assigned readings; recorded lecture; supplemental videos/podcasts; short assessment	Multiple access points addresses various learning modalities/allows students to self-monitor learning in conjunction with assessment; lecture/supplementary materials scaffold reading by highlighting key points or clarifying understandings; Lecture material can be chunked into 10–15 min segments to reduce cognitive load
During class	Lecture; one to two activities; Partner-Share	Lecture scaffolds reading by highlighting key points or clarifying understandings; Activities scaffold lecture by breaking up instructional input and reducing cognitive load; Partner sharing promotes structured interaction	Activities; Small group/partner work; Partner-sharing; Problem Sets; Assessments	Activities apply, develop or deepen knowledge acquired in reading/lecture; Partner and small group work promote structured interaction, allow for peer support, feedback and evaluation; Peer and instructor support can be given on in-class assessments
After class	Assessment	Students may review notes, independently seek support from peers, attend office hours or contact instructor for support	Complete assessments; Follow up activities	All students have access to peer/instructor feedback from in-class session; Assessments are completed independently to allow for more time and development; Follow up activities may further extend learning

chapter discusses how to select materials and support students when flipping parts of a traditional course.

Finding Opportunities to Flip

A key to finding opportunities to flip in a traditional course is to look for parts of the course that are already a natural fit for the flipped format. One place to start is looking at where students struggle. If, in examining a course, part of the struggle arises from the application of the knowledge presented through lecture, this may be a good part of the course to flip. By flipping this segment of the course, students will have access to a chunked version of lecture and/or a variety of content materials that they can access multiple times outside of class, according to their learning needs. Additionally, a simple knowledge-based assessment, that makes certain they have key understandings of the material prior to coming to class, leaves class time to scaffold more complex concepts and skills through interaction, group work, peer feedback and instructor support.

Another possible opportunity to flip might be in segments of a course that emphasize procedural knowledge (Stadler, 1989). Procedural knowledge lends itself well to the flipped format because content materials, examples and lecture can be given prior to class and class time can be used to apply this knowledge in authentic performance tasks. The nature of these tasks will vary by discipline; however, the procedural nature of the tasks make prerequisite tacit knowledge necessary, instructor feedback crucial, and collaborative work important; a clear opportunity to flip this aspect of the course.

Designing In-Class Learning Activities

With lecture moved outside of the classroom, in-class learning time can be used for various tasks appropriate to student learning. In-class time should be used strategically for student support and interaction, by and with peers and/or the instructor. This may mean that traditionally independent problem sets, with which students struggle, are tackled instead in-class, in groups, with the instructor circulating for support. Group work could be followed up by individual assessment; but the group process in class would serve as an intermediary scaffold to allow students to build and deepen their knowledge prior to demonstrating their understanding individually. Even simply integrating more structured interaction opportunities, like Think–Pair–Shares and Jigsaw Readings, where students can interact with one another to share their understandings of concepts or course readings, can be ways to enhance learning in a flipped classroom. Table 2 shows some of the potential uses of in-class time in the flipped model and the goals of these activities.

Table 2 Sample in-class interactive activities

Activity	Description	Goal
Think–Pair–Share	Students write or think about a given prompt/question, then share with a partner before sharing aloud	Increase and scaffold student participation
Class discussion	Students discuss class topic in small or large groups	Deepen understanding, share perspectives
Jigsaw Readings	Students are assigned different segments of a particular text to become experts on. They share their understandings of their segment of the text in small groups and learn from peers about other assigned sections.	Reduces cognitive load by chunking reading material; Encourages interaction, participation and accountability for knowledge
Group work on problem sets	Students work in groups on challenging problem sets	Scaffold understanding through peer interaction and instructor support
Scenario/Lab Activities	Students engage in hands on learning in authentic disciplinary situations	Encourages interaction and conceptual application
Rubric-based feedback	Students receive peer and instructor feedback using rubrics	Students interact with rubric criteria, understand how to improve

Another powerful use of class time might be scenario-based instruction where students apply knowledge to various situations. Working through scenarios in groups allows students to deepen their understanding of content through application and synthesis. In my teacher education courses, this type of applied scenario work has been one of the biggest benefits flipping has afforded me. Prior to flipping, there was simply not enough processing time between instruction on a concept and higher level scenario-based application of that principle, nor was there enough instructional time for students to be given a scenario, enact it and debrief it effectively. By flipping, students enter class possessing an initial conceptual understanding of the principles they are to apply in their scenarios. This acquired knowledge allows students to more efficiently think about and address the issues in the scenario, and the time previously taken by face-to-face lecture can now be used to more thoroughly develop, discuss and debrief these practical situations. In other disciplines, hands-on, inquiry based labs might serve a similar purpose to scenario-based work.

Finally, in-class time can be used to break down larger project-based assessments, allowing the instructor to monitor progress and clarify understandings, supporting students as they work through the assessment process. Students might also participate in peer writing and revision groups in class or in-class discussion, promoting peer interaction and support. An example of this from the module featured above in Fig. 2 (and below in Table 3) was a structured writing group for a large class assessment (the Student–Parent letter). Students shared their work with fellow students and received structured feedback while I circulated with support the process and answer questions. This type of peer and instructor scaffolding previously was not available

due to time constraints. However, its presence improved the quality and consistency of assessments that students produced and promoted a stronger learning community in the class.

Designing Pre-class (Independent) Instruction

In addition to choosing content and activities for the flip, we must consider what tools will best support our instruction, inside and outside of the classroom. For content-based work assigned prior to class, in addition to readings, many instructors find audio-video material (newly created specifically for the course or pre-existing) and other digital resources to be helpful. There are also a variety of digital tools an instructor might use for assessment. Examples of these digital tools and resources and how to deliver these resources are explored and discussed in Chapter 3 "Tools of the Trade: What Do You Need to Flip?" Whatever materials or resources are chosen, it is critical to prepare students by demonstrating how to access and use these, components of the course, embedding the necessary technology requirements into your syllabus.

The shifting nature of pre-class lecture and in-class instructional activities will likely require extra preparation on your part. This may include the design of new assessments or reformatting of previous assessments; the creation of scenario or lab-based activities; the strategic grouping of students to support their learning; and the active shift of your role from lecturer to instructional guide. Although you may continue to lecture via online instruction, in-class, you will likely be providing feedback to students. This may also require the design of rubrics to make feedback and follow-up clearer for students. Again, students need to be prepared for this change. They need to know that class time for the flipped segments of the course will not be spent re-lecturing material and that they are expected to fully participate in the activities during class. This may push instructors and students out of our comfort zones, but also should help students to more actively engage with and strengthen their own learning.

Reflections on the Process: Flipping Part of a Course

When choosing an initial learning module from my course to flip, I considered which concepts often proved most challenging for students, in terms of nuanced understandings and development, as well as the concepts that seemed the most difficult to cover in our allotted lecture time. Given these criteria and looking over my existing course objectives, I chose the "Classroom Management" module (previewed in Fig. 2) from one of my preservice teacher education courses. Classroom management was also an excellent topic to flip because lecture was largely theoretical, but students wanted more practice and application. The "Preparing the Classroom

Environment for Teaching and Learning" lecture from this module (previewed in Fig. 3) is presented below in Table 3, in both its traditional and flipped forms, and discussed in relation to the design and implementation process.

In reading through Table 3, first, we see that there is an expanded and differentiated set of objectives. By separating active instruction into the two discrete phases with support, rather than just assigning reading, it was important for me to establish clear objectives for both the online lecture portion of instruction as well as the in-class instruction portion. In the traditional version of this lecture, while there were similar objectives, these were less developed than in the flipped version because of the single phase of active instruction in the classroom.

In regards to assessment, although the summative assessments remained the same for this module, there was an additional formative assessment; students completed a classroom formation analysis and reflection prior to coming to class that served as the "check-up" activity for the pre-class materials. Students needed to have either viewed the lecture or completed the readings with enough understanding to complete the formation analysis embedded in the first part of the online lecture. This assured students' readiness to engage with the concepts at a more applied level in relation to their own future classrooms when coming to the face-to-face session.

Another key difference between the traditional and flipped versions of the course in relation to assessment was when assessments were completed. In the traditional version of the course, assessments, like readings, were assigned for independent work, with students occasionally seeking instructor support if they had questions. In the flipped version of the course during this lecture, there were opportunities for peer interaction and feedback as well as instructor feedback on both module summative assessments. Students received structured feedback during the Student–Parent letter writing groups and brainstormed aspects of their classroom management in class through activities during the face-to-face session.

Prior to class, as noted, readings were previously just assigned and lecture was based on an assumed understanding of the readings, reinforcing key concepts from the readings and giving real life examples and applications. In the flipped version of the class, there was more pre-class work to complete with the addition of the online lecture and assessments including the completion of a draft of the Student–Parent letter (in order for students to receive writing group feedback) and the completion of the classroom setting analysis activity. Again, these pre-class activities were essential for full face-to-face class participation.

The structure of the class, unsurprisingly, reflected the biggest differences between the traditional and flipped versions of the course, in ways that the table cannot fully represent. Although both versions incorporated activities that helped to chunk the course into more manageable segments for students to process, the nature and depth of the activities varied greatly between the traditional and flipped classrooms. In the traditional version of the course, students were required to process the lecture material and apply it immediately to a classroom situation through the activity. If students completed their readings, this engagement was easier, but the depth of their analysis was shallower given their reduced processing time and the fact that they had no earlier requirement to practice this application. In the flipped version of

Table 3 Comparison of key traditional vs. flipped instructional components

	Traditional model	Flipped model
Objectives	**Weekly Objectives:** • Students will understand multiple ways and experience a way to construct and communicate classroom expectations • Students will be able to communicate how expectations, procedures, and routines can assist with classroom management • Students will explore the way that physical set up can support student learning in their classrooms	**Pre-class lecture objectives:** By the end of this session, • Students will be able to communicate how procedures and routines can support their classroom management • Students will be able to design a physical classroom environment that supports classroom learning and their professional identity • As demonstrated on the pre-class and course assessments. **In-class objectives:** During class, • Students will give and receive feedback on their student–parent letters using the grading rubric • Students will be able to communicate how norms, procedures, and routines can support their classroom management • Students will explore the way that physical set up can support student learning in their classrooms • Students will design a classroom environment that corresponds reflects their beliefs related to the five functions of a classroom setting • Students will be able to choose and justify at least three norms, routines and/or procedures they will use in their future classrooms Through participating in various in-class activities.
Assessments (Formative and Summative)	**Summative (for module):** • Student–Parent Letter • Classroom Management Plan **Formative (for lecture)/Checks for Understanding:** • Exit Slip: – How will your classroom environment reflect your professional identity? – Why is your classroom environment important to student learning?	**Summative (for module):** • Student–Parent Letter (bring draft to class for feedback) • Classroom Management Plan **Formative (for lecture)/Checks for Understanding:** • Classroom formation analysis based on five functions of classroom setting (pre-class) • Exit Slip: – What are three norms, routines or procedures you will integrate in your own classroom? Why? – How will your classroom environment reflect your professional identity?

(continued)

Table 3 (continued)

	Traditional model	Flipped model
Work to be completed prior to class	**Readings:** **Weinstein and Novodvorsky (2011)**, Ch. 2 and Ch. 4, "Designing the Physical Environment" and "Establishing Norms for Behavior"	**Readings:** **Weinstein and Novodvorsky (2011)**, Ch. 2 and Ch. 4, "Designing the Physical Environment" and "Establishing Norms for Behavior" **Online Lecture:** • Part One: Designing a Physical Environment (12 min) • Part Two: Establishing Routines and Procedures (11 min) **Check-up Activity (Current week):** Bring Physical Environment layout and 150-word (min) rationale **Follow-up Activity (Previous week):** Bring full draft of Student–Parent Letter to class
Structure of class session (two and half hours)	• Welcome and Announcements (five to seven min) • Preview objectives (three min) • Quickwrite/Partner Share/Debrief (15 min): – Write about or draw out your ideal classroom or learning environment – Share one corner of your identity name tent and discuss your ideal "classroom" environment with your five o'clock partner • Lecture, part one: Establishing norms, procedures and routines (65–70 min with two sub-activities) – Introduction lecture (seven min) – Norm setting activity in partners/small groups (30 min) – Debrief and discussion (10 min) – More lecture (12–15 min) – Partner Share/ Debrief (six to eight min) • Lecture, part two: Classroom Setting (35–40 min) – Introduction to five functions of classroom setting (five min) – Evaluation of various classroom set-ups according to five functions of classroom setting (20 min) – Partner Debrief and discussion (10–15 min) • Review objectives/ check for understanding (five min) • Exit slip (five to ten min)	• Ticket in the Door (Students hand in check-up activity) • Preview objectives (three min) • Norm setting activity in partners/small groups (30 min) • Debrief and discussion (10 min) • Student–Parent Letter Writing Groups (30 min) – Students give feedback to one another on major class assignment brainstormed in class through structured writing process • Writing group debrief (seven min) • Four Corners Classroom Environment Activity/Debrief (20 min) – Environment philosophy – Discussion of check-up activity • Physical Environment Gallery Walk (20 min) • Routines and Procedures Give One, Get One (25 min) – Brainstorm – Share and share out – Debrief • Exit slip (five min)

	Traditional model	Flipped model
Independent work outside of class	• Readings for class • Student Parent Letter • Classroom Management Plan	• Readings and Online Lecture • Check-up activity • Finish Student–Parent Letter (started/feedback given in class) • Finish Classroom Management plan (seating chart discussed in class; norms, procedures, routines brainstormed, discussed in class)

the course, students began with a norm-setting activity that built upon schema both from lecture and from the previous course session, providing a model for their own future classroom application. Subsequently, they engaged with their Student–Parent letters, started in class the week before, again connecting new learning to previous learning and allowing them structure interaction and feedback from their peers and the instructor in order to improve their drafts. Student application of the design principles to their classroom space was scaffolded by the pre-class activity of formation analysis and then applied to their own future classrooms in a way that connected earlier work from the module on professional identity. The gallery-walk activity allowed students to be exposed to various ideas from their peers, another opportunity for structured interaction and sharing. Finally, "the give one, get one" instructional activity allowed for students to brainstorm, share and review classroom routines, procedures and expectations, an integral part of their classroom management plan. This final activity set the stage for the following week's explicit discussion of classroom management in theory and practice. In the traditional version of the class, following instruction, students were left to apply these ideas on their own in their management plans and student–parent letters. In the flipped version, while students still ultimately turned in individual assessments, the work in class allowed them to start on their assessments and get feedback prior to completing each assignment, allowing for less time spent on assessments outside of class and stronger final products.

Examining this single lecture helps to illuminate some of the differences between the traditional and flipped versions of this course. It also illustrates that flipping my lecture was not completely reinventing the wheel. In creating my online lectures, I took many of the slides from my original in-class lecture, and chunked them by topic. I retained some of the activity-based portions of the original traditional face-to-face session in the flipped version, but added opportunities to engage with assessments in class. I strengthened student accountability for the concepts and the readings introduced in this lecture, although the readings themselves remained the same. Similarly, although the assessments for the overall module remained the same, the process of completing the assessments was more clearly scaffolded to support stronger student products. Working with just a few lectures like this one, within a single flipped module, helped motivate me for the next step in the flipping process, flipping a full course.

Full Scale Implementation

Some of us may take an all-or-nothing approach and begin with full-scale implementation. For others this happens after developing proficiency and ease with one or more lectures/modules in an existing course. While the design principles and pedagogies for a fully flipped course are similar to those of a single flipped lecture, designing a complete flipped course requires more advanced planning and additional time to prepare course materials. Instructors must plan for, chunk, find or record

pre-class lecture materials each week; integrate problem-based and active learning strategies; monitor understanding through pre-class and in-class assessments, sustain momentum throughout the entire quarter or semester, and ensure that students are fully prepared for the flipped shift in instruction. The syllabus must be organized and designed to clearly convey the course objectives and format; and the assessment structure must be aligned to support both pre-class and in-class participation. Here, we briefly explore flipping a new or existing course, followed again by an outline of my process flipping a course and some reflections on my first flipped course process.

Fully Designing a New Flipped Course

While the initial investment of time and effort, and the waxing and waning of student motivation may be challenges in designing your flipped course, the benefit to designing a fully flipped course includes consistency of format, expectations, and deeper learning opportunities for students. If designing a fully flipped class for the first time, there are several instructional design models (Carr-Chellman, 2015; Gagné, Briggs, & Wager, 1992; Morrison, Ross, Kemp, & Kalman, 2007; Reiser & Dick, 1996; Seels & Glasgow, 1998) that align with and expand the basic design principles discussed in this chapter. These fuller models provide cohesive and consistent instructional design frameworks that consider technology integration, proving useful for flipped instruction that spans a quarter or semester. Integrating an instructional design model that addresses the use of technology in the classroom and aligns with the aforementioned design principles will help build a structure of consistency and clarity for students.

Flipping an Existing Course

Rather than flipping a new course, there may be an existing course that is a strong candidate for a full flip. The advantages to flipping an existing course are instructor familiarity with the material and goals for the course itself. Often preexisting lectures can be chunked and modified to fit the flipped format, leaving time for more active learning in class throughout the quarter or semester. When flipping an existing course, however, the syllabus, lectures and in-class activities will need revision. Students will still need to understand that there will be no lecture in class, and instructors may need to integrate additional pre-class assessments to ensure prerequisite understanding prior to the class session. Finally, the nature and expectations of in-class participation may change as students will need to be held accountable for their attendance, participation, and engagement in the group activities integral to the course. Because of these changes, many of the same instructional design models recommended for designing a new flipped course can also be important in converting a traditional course to a flipped format as we will see in my reflections on flipping a full course.

Reflections on the Process: Flipping a Full Course

In flipping my "Curriculum, Instruction, Assessment and Classroom Management" course, I found Gagné et al. (1992) nine events of instruction to be a helpful framework for a procedural analysis that incorporates the simplified design principles discussed earlier in the chapter. The simplified design principles were largely sufficient to flip a single lecture or even a single module. However, when flipping an entire course, consistency was key to success. Using a fully established instructional design framework proved essential in establishing structures to achieve this consistency. Following the nine events of this framework, I have briefly outlined my process for designing a fully flipped version of my "Curriculum, Instruction, Assessment and Classroom Management" course. In contrast to the heavy focus on instructional shifts featured throughout the rest of the chapter, this final design section focuses on structural design elements used throughout the entire semester to support flipped instruction.

Event One: Gain the Attention of Students

In this first stage of course redesign, I needed to figure out a regular way to prepare students for the topic that we would be covering each week. Traditionally, I had used topical quick writing activities to begin class and I planned to continue to do so in face-to-face sessions; however, with the flipped model, I also needed to gain students' attention and focus them on the topic for each week in a structured, consistent way, while at a distance. I did so through the use of a weekly e-mail previewing the week and an overview page which had a brief introductory paragraph about the topic, assignments and readings due that week and a link to a checklist to track student task completion. This online checklist was broken up into pre-class, in-class, and after-class activities to facilitate student use. I have seen other instructors embed short videos in a similar overview page, but I decided to keep it simple for my first flip.

Event Two: Inform Students of the Objectives

As noted earlier in the chapter, students need consistent, clear communication of the objectives throughout the learning process in a flipped model. Throughout the course, objectives were embedded in multiple places including the weekly overview document, the syllabus schedule of topics, at the beginning of each lecture chunk, at the end of the final lecture chunk for the week, and at the beginning and end of the in-class session. This allowed students to stay aware of the goals in each phase of instruction each week while also contextualizing how the goals fit together in the larger framework of the course.

Event Three: Stimulate Recall of Prior Learning

Again, the activation of background knowledge is a critical feature to support student learning. In the flipped version of the course, I made sure to design the course in a way that would allow me to draw on prior knowledge from previous weeks in class, as well as drawing from the lecture itself, during the face-to-face sessions. The only initial difficulty with this was that I was often recording lectures a week ahead of time so I needed to review the content of the lecture just prior to the face-to-face session to be able to effectively draw connections to content for students. This was good practice for me, however, in connecting lectures and material to one another.

Event Four: Present the Content

As evidenced by the flipped lecture in Table 3, above, content was presented in two phases, as is characteristic of the flipped model. Pre-class activities always included a recorded lecture component and readings, although check-up formats ranged from multiple choice and short-answer quizzes to discussion boards and analysis-based activities. The content was presented outside of the course then reinforced in face-to-face sessions. Due dates for pre-class assessments remained consistent throughout the semester to facilitate routine for students.

Event Five: Provide Learning Guidance

In the flipped version of the course, learning guidance was provided through the face-to-face course sessions in the form of opportunities for structured feedback, opportunities for lecture-based question and discussion, and various learning strategies. Understanding of the lecture was scaffolded by both the pre-class check-up activities and role-playing/visualizing activities in class. This was distinct from the previous traditional version of the course in which events four and five often took place together in the lecture-based face-to-face session. In the traditional version, less learning guidance was provided as the focus of the face-to-face session was necessarily on presenting content.

Event Six: Elicit Performance (Practice)

Whereas the face-to-face sessions in the traditional version of the course often combined events four and five, the flipped version face-to-face sessions blended events five to seven. Students participated in many practice-based activities including scenario-based concept application and reflective writing or sharing. These opportunities for performance and practice were especially important for students as they encountered more complex challenges through performance and practice. When students worked through these challenges, they developed deeper conceptual and practical understandings.

Event Seven: Provide Feedback

Prior to flipping this course, there were two structures for feedback. The instructor gave feedback on each assignment and there was a multi-week discussion board activity that allowed students to give weekly feedback to partners about unit design. The integration of this discussion board activity in the traditional version of the course allowed for student interactive feedback outside of the course, but consistently proved problematic when a few students would miss discussion board post and response deadlines each week as the semester progressed. By providing structured opportunities for feedback in face-to-face sessions, students benefitted from receiving consistent instructor and peer feedback and received formative instructor feedback prior to assignment submission rather than solely receiving evaluative feedback following submission.

Event Eight: Assess Performance

The summative assessment process remained essentially unchanged in the course flip; however, the increase in formative assessment opportunities proved initially challenging, but eventually fruitful, for all parties. Initially, in conceptualizing how to assess student understanding and completion of pre-class activities each week, I envisioned having to create entirely new assessments worth significant points to encourage completion. In reality, I did create some simple quizzes, but often took prompts that had initially been integrated into the face-to-face traditional session to check for understanding and reworked them slightly to assess understanding of the pre-class lecture based assignments in the flipped version of the course. While I added an initial "point category" to the overall grading criteria for the course, when divided up over the semester, pre-class assessments counted for approximately 10–15% of the course total points, an amount that I thought was fair given that the purpose of pre-class assessments was to measure prerequisite, basic knowledge of core course objectives. The pre-assessment process allowed me assess students' initial understandings coming into class (as the pre-class assessments were due a day prior to class itself), giving me a sense of how to connect new learning to the established schema and where students might be experiencing confusion in relation to the lecture.

Event Nine: Enhance Retention and Transfer Knowledge

The final event in Gagné and his colleagues' framework was perhaps the most important, as it involved internalization of knowledge and the ability to transfer this knowledge to a workplace setting (in my case, to a future classroom). For me, this was the largest motivator for flipping my course. While previously, the large scope of the course meant very broad and cursory coverage of four essential topics to teacher success, flipping this course allowed for multiple exposures to the concepts in the course, deeper understanding and engagement with topics for more than just the two and half hours per week that I saw students. This allowed students to retain

course concepts to a greater degree and transfer that knowledge to their course assessments and their future classrooms.

While we do not all teach teachers, the principles of designing and flipping a lecture, module, or class remain similar. Whether a physicist, mathematician, teacher educator or historian, we all have concepts that need deeper coverage or for which students need additional supports and regular opportunities for interaction and feedback. Through the use of consistent structures to promote learning, the flipped classroom can allow for such opportunities on a weekly basis, changing the nature and degree of teaching and learning in the classroom.

The Flipped Mindset

There is one final critical component to flipping your course. Flipped classroom practitioners and advocates (Durley, 2012; Flipped Learning Network, 2014; Siegel, 2012) note that flipping the classroom involves more than changing the format of a course; more critically, flipping involves changing one's own instructional mindset and supporting students in changing their mindsets and approaches to the course. Flipping *requires* students to access the content outside of class in order to participate in the activities in class. With no lecture to reinforce key concepts, students should be responsible for accessing and developing an initial understanding of key course ideas independently and must monitor their own learning. As instructors, we have to resist the temptation to re-lecture assigned course material; instead, we need to examine the nature of the activities we provide to students in class; challenge ourselves to integrate more inquiry based, interactive instructional activities that apply student knowledge; be ready to actively provide feedback that supports and deepens students' initial understandings of the material; and continually reflect on our experiences with flipping to strengthen our practice. It is important for us to be patient in this process, both with ourselves and our students.

Promoting and Maintaining a Flipped Mindset

The flipped mindset for students is based upon self-regulated learning, collaboration skills, and active engagement with the learning process, all components central to adult learning theories (Banas & Velez-Solic, 2013). Students who excel in the flipped classroom must be responsible for their pre-class learning and willing to work with their peers and instructor collaboratively through active engagement in in-class activities. We can encourage this mindset through pre-assessment accountability measures and maintaining the flipped model with fidelity and designing activities that require the use of content knowledge in collaborative ways to complete successfully.

For the instructor, the flipped mindset also requires active engagement through reflection. Prior to flipping, we must honestly assess our strengths and weaknesses

in relation to technology, instructional planning, inquiry-based and collaborative learning, finding resources or support to overcome areas of weakness while drawing from areas of strength. During the course, we must constantly reflect on student learning and participation, while giving regular feedback to students. Reflection in practice and adaptability will promote greater sustained momentum in the flipped classroom. Finally, after any flipped course, reflection on how to improve the materials and methodologies for the following course is imperative to ongoing professional growth.

Benefits of a Flipped Mindset and Flipped Instruction

The flipped mindset is one of constant reflection, engagement, and examination. Such a mindset is relevant to the classroom and to the professional and academic dispositions we hope to promote in our students. While flipping instruction requires shifting mindsets and an initial investment of time to restructure and redesign a course, the benefits of flipping in terms of student engagement, learning, and increased benefit from the course (Mok, 2014), will likely outweigh the initial sense of being overwhelmed for instructors and students. Whether flipping a single lecture or entire course, with clear objectives, well-chosen and chunked materials, and active, engaging class sessions, instructors and students can experience the powerful learning opportunities of the flipped model.

Keywords/Phrases

1. Learning Objectives: Specific, measurable goals for student learning
2. Chunking: Breaking material down into smaller segments
3. (Instructional) Scaffolding: Support given during the learning process, tailored to the needs of the student to help the student achieve his/her learning goals
4. Schema: Background knowledge or stored information
5. Procedural knowledge: Knowledge exercised in the performance of a task

Discussion Questions

1. What are the biggest benefits and challenges to you, as an instructor, in considering flipped instruction?
2. How does instructional design in a flipped format align and/or differ from your current instructional design practices?
3. How can you maintain momentum and promote the flipped mindset among your students throughout your course?

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References

Banas, J., & Velez-Solic, A. (2013). Designing effective online instructor training and professional development. In J. Keengwe & L. Kyei-Blankson (Eds.), *Virtual mentoring for teachers: Online professional development practices* (pp. 1–25). Hershey, PA: IGI Global.

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Alexandria, VA: International Society for Technology in Education & Association for Supervision and Curriculum Development.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals* (Handbook I: Cognitive domain). New York, NY: David McKay Company.

Carr-Chellman, A. A. (2015). *Instructional design for teachers: Improving classroom practice* (2nd ed.). New York, NY: Routledge.

Durley, C. (2012). *Flipped classroom renovates mindset| A fine balance*. Retrieved May 19, 2015, from http://flipperteach.com/2012/12/09/flipped-classroom-renovates-mindset/

Flipped Learning Network. (2014). *The four pillars of F-L-I-P*. Retrieved May 19, 2015, from http://flippedlearning.org/cms/lib07/VA01923112/Centricity/Domain/46/FLIP_handout_FNL_Web.pdf

Gagné, R. M., Briggs, L. J., & Wager, W. W. (1992). *Principles of instructional design* (4th ed.). Fort Worth, TX: Harcourt Brace Jovanovich College Publishers.

Garrow, L., Hotle, S., & Mumbower, S. (2013). Flipped classroom. *OR-MS Today, 40*(4), 10.

Mok, H. (2014). Teaching tip: The flipped classroom. *Journal of Information Systems Education, 25*(1), 7.

Morrison, G. R., Ross, S. M., Kemp, J., & Kalman, H. (2007). *Designing effective instruction*. Hoboken, NJ: Wiley.

Raths, D. (2013). 9 video tips for a better flipped classroom. *THE Journal, 40*(11), 12–18. Retrieved from http://thejournal.com/Articles/2013/11/18/9-Video-Tips-for-a-Better-Flipped-Classroom.aspx?Page=1.

Reiser, R. A., & Dick, W. (1996). *Instructional planning: A guide for teachers*. Boston, MA: Allyn & Bacon.

Schwier, R. A. (1998). Schwiercourses, EDCMM 802. Unpublished manuscript, University of Saskatchewan at Saskatoon, Canada.

Seels, B., & Glasgow, Z. (1998). *Making instructional design decisions*. Upper Saddle River, NJ: Prentice Hall.

Siegel, M. (2012). *Flipped approach: Flipping the mindset*. Retrieved May 19, 2015, from http://aflippedapproach.blogspot.com/2012/09/flipping-mindset.html

Soloman, H. (2013). *Instructional design: Cognitive load theory*. Retrieved May 21, 2015, from http://www.instructionaldesign.org/theories/cognitive-load.html

Stadler, M. A. (1989). On learning complex procedural knowledge. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15*(6), 1061–1069.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction, 4*, 295–312.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Tools of the Trade: What Do You Need to Flip?

Steven R. Crawford and Jinnette Senecal

Abstract This chapter answers one of the big questions that instructors new to flipping content often have: "What do I use to do this?" Though technologies are forever evolving, this chapter covers the "tools of the trade" and guides readers in deciding which tool characteristics are best, be these low or high-tech. The chapter also reminds readers to chunk content into manageable bits of information, using a combination of low- and high-tech tools.

Introduction

Now that we have considered the structure and design of a flipped course, we need to consider the role of technology and which tools to use when flipping. While it is possible to flip the classroom without the use of technology, readily available online technologies have accelerated the adoption of the flipped classroom model. The most prevalent role of technology is in the creation and delivery of online presentations (i.e., the "lecture" and/or instructional material provided to students between one class and the next). However, other roles include the ability for technology to bridge the online and classroom experiences, conduct formative and summative assessments, and enhance the classroom active learning experience. In this chapter we discuss how low- and high-tech forms of technology can be used to support both the online and classroom components of a flipped course.

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Using Existing Digital Resources

Prior to designing and creating our own instructional materials, we recommend beginning by surveying available online materials. Some of the factors we consider when selecting online resources include:

- *Educational fit*. Does the content meet our educational goals without being overbroad or too deep?
- *Credibility*. Was the content developed by a credible source such as an institution of higher education, government agency, or reputable foundation/organization?
- *Availability*. Is the content available for me to use in my courses? Does the content have a Creative Commons license or terms of agreement that allows for the content to be used in an educational setting?

When we begin a search for content, we often start with well-known repositories such as MERLOT (http://www.merlot.org), TED Talks (http://www.ted.com/), TED-ED (http://ed.ted.com/), Open Educational Resources Commons (https://www.oercommons.org/), and YouTube Channels produced by reputable sources. Another key resource to explore is your campus library as they may have a wide variety of digital resources and repositories. If you are using a commercial textbook, the publisher may provide complementary digital resources. When we cannot find the instructional materials we need, we then begin the process of developing our own resources and online presentations.

Effective Online Presentations

While there are many ways to transform in-class lectures to pre-class learning activities, delivering multimedia presentations is a common approach. Developing online presentations involves more than standing in front of a camera and speaking to it. Video may not be the most effective way to present the content of a flipped course. We will start by exploring the various types of online presentations, then take into account the logistical considerations, and finally look into online presentation design.

Four Types of Online Presentations

When designing and developing online presentations, it is important to choose the presentation format that best matches the pedagogical and technical goals of the presentation. The four basic types of online presentations include: audio recordings, voiceover presentations, screencasting, and video. Some presentation types may be suitable for addressing similar pedagogical goals; however, some presentation types may require significant technical skills to construct.

Audio Recording

Audio recordings are most appropriate when the content being conveyed does not require the assistance of visuals. This type of online presentation can be very useful for providing an overview to a module or introducing a new unit. Another use is to interview a guest speaker when visuals are not available. Recording audio can be quite simple when using an app on a mobile phone or a microphone on a laptop; but, these devices may pick up other environmental noises and echoes. Using a higher quality microphone will improve the recording; however, to achieve the highest level of clarity, a studio or sound booth can be used to reduce distracting noises and interference.

Voiceover Presentations

When developing lectures online, voiceover presentations can be one of the simpler yet effective presentation types. To create a voiceover presentation, an instructor will typically record audio that is embedded in a slide presentation so that the students experience a synchronized audio lecture in accompaniment with the visual elements. A key difference between voiceover presentations and audio recordings is that the audio narrative is part of the lecture content as opposed to being a standalone resource.

There are a number of software packages that will record audio and synchronize it to the slides in the presentation. If the original files are retained, it is often possible to quickly revise segments of the presentation as needed without having to rerecord everything. Many of these publishing tools require very little time to learn, and some contain advanced features that support embedding formative assessments into the presentation to elicit student interaction. Modern versions of these packages will seamlessly create presentations that are viewable on mobiles devices.

Screencasting

Screencasting has become a popular way to visually orient students to Web-based resources such as their course site, or complex procedures such as navigating research databases. Other uses for screencasting include demonstrating a procedure in a software package or providing feedback to a student on an assignment. Screencasting differs from voiceover presentations due to video being captured from the desktop as opposed to the static images of a voiceover presentation. In addition, the captured screen video could be edited to highlight portions of the screen, add captions and annotations, or to zoom into particular sections for emphasis.

Most of the packages for creating screencasts will export finished video that can be posted to common video distribution sites, such as YouTube. Due to the more complex screen video recording process, it is often easier to record a new presentation than attempt to edit an older one. Also, just as with voiceover presentations, it is important to ensure that the highest quality audio possible is recorded so that distracting environmental sounds and echoes are minimized.

Video

Early efforts in the late 1990s and early 2000s made in developing flipped courses involved recording lectures onto VHS tapes for students to check out of a library prior to class (Lage, Platt, & Treglia, 2000). While video can be a powerful way to communicate instructional content, it is also an overused presentation type. The process for creating video can appear to be relatively simple; however, extensive video production skills are required to effectively create more complex, informative types of video presentations.

There are several things to consider when developing video presentations. A major consideration is the importance of seeing the presenter. If seeing the presenter during the presentation is not critical to effectively conveying the material, then one of the other presentation types may be more appropriate. Another thing to consider is whether the content will need to be edited. Editing a published video is often complex; therefore if the content being presented is likely to require frequent revision, a different presentation type may be more suitable.

When developing a video presentation, we need to consider how to best convey the content and evaluate the different levels of production complexity depending on the type of video presentation. To assist with this we have identified three subtypes of video presentations: monologue videos, dialogue videos, and demonstration videos.

Monologue Video

Monologue video is when the presenter is speaking directly to their audience through the camera. For example, a presenter may do this in order to introduce a course, a module, or themselves.

Recording and publishing video has become much easier with the proliferation of high definition cameras being built into laptops and mobile devices. Some instructors will record “one take” videos and unless there are any major flaws, the software will then automatically publish to common video distribution sites. Whereas, other instructors will choose to use a studio where a video production team will record the presentation to video and add graphics to improve the visual the finished video.

Dialogue Video

Dialogue video is best characterized as video that captures a conversation. This includes interviews or the recording of a lecture given at an event or in a class session. A type of dialogue video that is emerging is to stage a presenter in a studio and have him/her lecture to one or two students. This is done so that the students participating in the studio can ask questions of the lecturer that students may commonly ask.

While dialogue videos can be easily recorded using a single camera, the quality can be greatly increased by the primary speaker in an interview or classroom lecture with a remote microphone. Otherwise, using the built-in microphone on a single camera in the back of a room will pick up all of the environmental noise such

as people shifting in their chairs and may not adequately record the speakers. If available, a video production team can be useful for providing multiple microphones and multiple cameras so that the final product always has a camera focused on whoever speaking at all times.

Demonstration Video

Demonstration videos can be some of the most intriguing but most resource intensive presentations to create. This subtype is characterized by a video that demonstrates a process or scenario. One use for this type of video is to demonstrate how to use a piece of equipment or a procedure. Another usage is to provide a role-play, case study, scenario, or vignette for students to analyze and/or decide how to respond to the situation.

This subtype can be difficult to develop as it requires a lot of planning which includes developing a realistic script, having the "actors" rehearse their lines, and, finding a suitable location to record. Low video production quality can be more distracting for this subtype of video; therefore a video production team should be involved in the shooting and editing of the video as multiple cameras may be needed and the actors may have to record each part several times in order to capture the video footage necessary to create a quality video.

Logistical Factors to Consider

Ideally, the pedagogical needs would be the primary consideration when choosing a presentation type; however, there are several logistical factors that can influence how to approach the development and delivery of online presentations. As shown in Table 1, the majority of the content that can be delivered online can potentially be accomplished with several presentation types. In these cases, there are five logistical factors to consider when choosing the most appropriate presentation type:

- How much *time* is available to create the presentation?
- How much *effort* will be needed to use the tools for creating the presentation?
- What is the *cost* of the tools required to develop the presentation?
- Will the presentation be *reused* in other courses?
- Will the audio/video production *quality* level be in alignment to the expected instructional use pattern?

If we expect to reuse a presentation from term to term, then it may be worth the time and cost to work with video or multimedia developers in order to increase the level of quality and to avoid a level of effort that may exceed your level of expertise and/or your development timeline. Short presentations that address immediate instructional and social needs may not require a high quality production. Simple techniques such as recording from a computer's webcam and microphone may provide a level of quality that is adequate for the goals of the presentation.

Table 1 Presentation types for online content

Content	Audio	Voiceover presentation	Screencasting	Monologue video	Dialogue video	Demonstration video
Podcast	X			X		
Course introduction	X	X	X	X		
Personal introduction	X	X		X		
Module introduction	X	X	X	X		
“Lecture”	X	X		X		
Student feedback	X		X	X		
Course announcements	X			X		
Interview	X				X	
Event/Lecture capture	X				X	
Application/Process			X			X
Role play	X					X
Case study/Scenario/Vignette	X	X				X

Online Presentation Design

When beginning to flip a course, there may be a tendency to voiceover unaltered, standard in-class lecture slides for reuse online. Another method may be to record a traditional hour-long lecture in a studio as video presentation. The concern with these approaches is that we may be creating "shovelware." Morrison and Anglin (2006) define shovelware as an approach where an instructor uploads lectures as quickly as possible without consideration for the length, appearance, or organization of the content, detracting from the online learning experience. A reason why this occurs is often due to courses being taught in one-hour blocks; therefore an instructor will automatically deliver as much content as they can fit into that standardized time block. We realize it is sometimes difficult to consider an alternative method to the hour-long lecture.

For the online portion of a flipped course to be as effective as possible, instructors and course designers need to leverage the advantages of the online learning environment and avoid creating shovelware for their students to consume. Two effective alternatives to the traditional lecture are minilectures and microlectures.

Minilectures

Lectures should be "chunked" into smaller minilectures. Chunking content is when larger units of information are broken into smaller bits (Miller, 1956). Miller explains that the reasoning for doing this it will help a student remember more of the information and be able to recall that information. This is because Miller found that short-term memory was only capable of handling a limited amount of information at any given time (see chapter "Step by Step, Slowly I Flip" for a discussion on memory and cognitive load).

One of the concerns with the hour-long classroom lecture is that students only remember portions of the lecture. Studies have shown that students typically remember only 10–20 min of an hour-long lecture (McLaughlin et al., 2014; Medina, 2008). When lectures are moved out of the classroom and flipped into the online learning environment, instructors and course designers are free of the time-based limits imposed by the classroom schedule to deliver content to students. To better leverage the online learning environment, instructors and course designers should focus on chunking their lectures into minilectures that are 10–15 min in length.

Another reason for chunking content into minilectures is that in the online environment the length of the video impacts how much of the video is viewed. In 2012, a video hosting service analyzed the viewing patterns of the videos they hosted and found that the longer the video, the less likely that it would be watched all the way through (Ruedlinger, 2012).

When designing microlectures, the online presentations should be focused on a single topic that lasts 10–15 min. A course module may contain multiple minilectures allowing for the same amount of content to be presented online as would have

been presented in the face-to-face classroom. In addition, there should be a focus on both the quality of the visuals used and the clarity of the audio. Therefore these minilectures should be designed in a way to maximize the reusability in a course from semester to semester. Course specific information such as sequencing and assignment due dates should not be included within a minilecture. Instead, the sequencing and date related information should be provided through microlectures that are also included in the course module.

Microlectures

While minilectures are the primary vehicle for conveying information online, microlectures can often be viewed as the glue that forms the course module. Microlectures differ from minilectures in several ways: they are shorter in length, not typically reusable, and not intended to be the primary vehicle for delivering content.

Microlectures are typically no longer than three min in length. This short format allows for an instructor to quickly orient students to key information in a course. This information may be related to upcoming assignments, connecting the content of the course to current events, and providing context for multiple minilectures. Since microlectures are not considered to be reusable and the length is relatively short, the quality of the audio and video becomes less critical as well.

Microlectures can be used to introduce a course module to the students so that they can quickly understand what is expected of them and how the parts of the module fit together. Another use of microlectures is for course announcements as an opportunity to address questions by students. An instructor may also choose to use a microlecture to provide descriptive feedback to a student on an assignment. No matter how microlectures are used, they can be a valuable means to assist students in engaging with the content of the course.

Bridging The Online Environment to the Face-to-Face Classroom

A key element for a successful flipped classroom is designing and implementing a deliberate bridge between the online and face-to-face instructional components. Ideally, there should be a purposeful flow of active learning activities and assessments across the two environments, rather than stand-alone online lectures and isolated classroom application activities. One of the most significant challenges that instructors often face is ensuring that students come to the classroom prepared; but fortunately there are a number of tools in the online environment that can be applied toward the realization of this goal.

Another important aspect to consider when flipping a course is how to efficiently and effectively manage assessment of student learning outcomes. One of the clear benefits afforded by the flipped model is that conducting applied, active learning

activities in the classroom offers diverse opportunities to formatively monitor student progress and adjust instruction to immediately address gaps or misconceptions as needed (Bergmann & Sams, 2014). Similarly, the flipped class model provides room for creative reengineering of summative assessments.

Online Preparation Exercises for In-Class Projects/Applied Learning Activities

Popular modern learning management systems (LMS) such as Blackboard, Moodle, Desire2Learn, Sakai, and Canvas are feature-rich with activity and assessment tools that can easily be leveraged to support a flipped classroom model. Although these learning systems may be primarily used to host online instructional content such as lectures and reading materials, they also provide a platform to guide students through active preparation for in-class activities.

These exercises might include brief written analyses of reading assignments, small group peer discussions, case study reviews, sample problems, and more. Regardless of the form of the exercise, ultimately the goal is to ensure that learners come to each face-to-face class well-prepared for active learning rather than just passively receiving informational content online. This strategic, intentional bridging promotes constructive knowledge building and underscores the responsibility of the learner in achieving successful learning outcomes.

Gillette and Gillette (2015) suggest that the naming convention of preparation exercises is central to emphasizing the role and importance they take. They recommend explicitly labeling these exercises as "class preparation assignments" and categorically weighting their value within the course assessment plan as a vital and required element. Gillette and Gillette (2015) further stated that the "definition of an 'A' student is one who not only does 'A' work on the exams and quizzes, but who also comes to class prepared at least 90 % of the time" (para. six). Although this method of grade weighting may not be appropriate for every course, it is an example of how to convey to students the importance of and expectations for completing online preparation exercises.

Formative Assessment

Robert E. Stake's classic analogy illustrates the conceptual role of formative and summative assessment: "When the cook tastes the soup, that's formative. When the guests taste the soup, that's summative" (Scriven, 1991, p. 169). With the shift toward active, constructive, student-centered learning in a flipped class model, formative assessment is key to proactively monitoring student progress toward learning outcomes and identifying critical knowledge gaps or misconceptions (Bergmann & Sams, 2014).

While some formative assessments are most effective when conducted face-to-face in conjunction with relevant learning activities, the online environment also provides powerful tools for developing formative assessments such as quizzes, surveys and polls, short-answer written assignments, peer-grading activities, reflective journaling, and more. Gikandi, Morrow, and Davis (2011) affirm that improved learner engagement and self-directedness are benefits that can be realized from online formative assessment. Ultimately, deploying formative assessments online reinforces the connection and flow between the classroom and online environments, and frees up valuable face-to-face class time to address any identified deficiencies.

Online Quizzes

Administering quizzes online is a low-risk, time-efficient way to gauge the progression of student learning on key course concepts and topics. Quizzes that incorporate objective question forms such as multiple choice, true/false, matching, ordering, or fill-in-the-blank can be developed in the LMS with automatic grading and feedback response features. Automated quantitative analysis of quiz outcomes provides instructors on-demand, focused identification of topics on which students may need additional instruction and support.

Surveys and Polls

Conducting surveys or polls online can quickly provide an overview of student understanding, agreement, belief models, and more. Presenting a survey or poll is a great option to consider for formative assessment when the subject is more qualitative in nature, or not well suited to an automated grading function. Many LMS survey tools provide options for collecting answers anonymously, which may help elicit more direct and open student responses on sensitive topics.

Summative Assessment

Just as flipping a course provides opportunities for adapting and streamlining formative assessments, there are also options to consider for redesigning summative assessments. Alignment across course learning objectives and curriculum design should be maintained, but some common approaches include:

- *Shifting exams out of the face-to-face classroom and into a computer-based, online testing environment.* Some LMS are equipped with features to minimize the risks of cheating and plagiarism. Ideally, the overall pedagogical design of the exam should also make it very difficult or unrealistic to cheat. This form of summative exam may best be realized as an open-book/open-resource test with subjective, individualized questions or problem-solving processes that require

demonstration of mastery at all steps. Some exams may be structured in a way to encourage students to constructively collaborate online, such as solving a problem or building a digital prototype too complex for one individual alone.

- *Shifting summative projects / assignments into the face-to-face classroom.* In courses that rely on a complex final project traditionally completed outside the classroom, a flipped model may allow for a robust in-class project development experience, perhaps even in structured collaborative peer groups. This approach potentially also affords the instructor a rich opportunity to observe and evaluate the process as well as the final product.

These are brief examples of the possibilities for designing assessments in the flipped classroom. When an instructor's role evolves from disseminator of information to facilitator of learning, it often means that the methods for assessing learner understanding and mastery will evolve too.

Using Technology for Active Learning and Engagement in the Face-to-Face Classroom

When flipping a class, much of the technology focus is centered on moving static lectures *out* of the face-to-face classroom and *into* the online environment. This shift opens a new horizon of opportunity for engaging applied learning experiences in the classroom, and there are many technology tools that can easily be employed to support these goals.

Low-Tech Tools for Active Learning in the Face-to-Face Classroom

At the least technically complex end of the spectrum are tools such as flip chart pads, sticky notes, and colored note cards. Flip charts are excellent tools for collaborative student projects, compare-and-contrast activities, topic/term categorization activities, and brainstorming activities. An eye-catching, brightly colored assortment of sticky notes can be applied to rapid descriptive prototyping activities, concept mapping, graphically planning and organizing project phases, keyword/concept summaries, and much more. Note cards may be seamlessly employed for low-stress formative assessments and rapid knowledge checks, either by collecting short written responses or using color-coded note cards as a visual response indicator.

Mid-Tech Tools for Active Learning in the Face-to-Face Classroom

For interactive or collaborative learning activities, a bring-your-own device (BYOD) strategy offers a high degree of engagement while minimizing the challenges of scheduling computer labs and the need for complex technical training and support. Student-owned laptops, tablets, and/or smartphones are generally well-suited to

accessing mobile-compatible quizzes from the course LMS, contributing to online shared documents, conducting simple Web-based scavenger hunts, or responding to real-time polls via text messaging.

Interactive response systems (also referred to as *clickers*) may be an option at some institutions, and most provide learning assessment and/or participation data analysis tools as additional benefits. Some clicker systems are based on proprietary hardware devices that students would individually purchase, rent, or check out from a library. Many response system developers also now offer mobile apps that can be purchased or subscribed to on student mobile devices rather than requiring purchase of a separate piece of hardware. Many clicker systems support direct integration into the institutional LMS for grade tracking, classroom attendance metrics, and more.

High-Tech Tools for Active Learning in the Face-to-Face Classroom

For dazzling, high-tech active learning classroom experiences, some institutions may provide access to interactive display systems such as touchscreen electronic whiteboards or simultaneous split-screen projection systems. These tools are extremely versatile for manipulating digital materials, displaying interactive multimedia, and working on collaborative projects.

The downside of such complex technologies is the high cost to set up, maintain, and support them. To effectively and fully realize the capabilities of these tools, the instructor may need fairly extensive technical training and instructional design support. Whether implementing simple, tried-and-true tools or sophisticated devices in the classroom, it puts constructive student learning at the center.

Conclusion

The timing of the increase in popularity of the flipped classroom model has been somewhat parallel to the expanding role of technology in higher education in general. However, to fully execute an effective flipped course, the strategic use of technology must be appropriate to the learner needs and match the pedagogical goals of the course. This includes the technologies selected for development of learning materials, but also those used for assessing learning outcomes and supporting applied classroom activities. Regardless of the technologies we choose, they must be chosen with the learner in mind.

Discussion Questions

- What are some of the technological issues to consider when creating online presentations?
- How do you decide which tools to use to promote students coming to class prepared?

- How can you use technology to effectively bridge the online environment with the classroom?
- What is the role of formative assessment in a flipped class?

Glossary

- **Formative Assessment**—An assessment type that is designed to assist both students and instructors in monitoring the progress of student learning and to identify gaps in understanding that need addressing.
- **Microlecture**—A lecture presentation that is less than three min in length and is designed to connect content and ideas, but not deliver them.
- **Minilecture**—A lecture presentation that is often 10–15 min in length and is designed to convey a single concept of the course content.
- **Screencast**—A video recording of the visual output of a computer desktop or application with a narration provided to explain the process being shown.
- **Summative Assessment**—An assessment type that is designed to evaluate student learning outcomes at the end of an instructional unit and/or course.

About the Authors

Steven Crawford is the Associate Director for Academic Innovation at Arizona State University's College of Nursing & Health Innovation. His team works with faculty to implement strategies to improve student learning in face-to-face, blended, and online courses. Steven has been involved in both the technical and pedagogical aspects of higher education for over 20 years. During this time he has developed numerous online degree programs and models to support blended and flipped courses. His research interests focus on preparing faculty members to effectively use technology to improve the teaching and learning process.

Jinnette Senecal is an experienced instructional designer and technologist at Arizona State University. She specializes in collaborating with faculty on course design and technology integration to promote positive student learning outcomes. Jinnette also enjoys teaching courses on the design and implementation of instructional technology for preservice K12 educators.

References

Bergmann, J., & Sams, A. (2014). Flipping for mastery. *Educational Leadership, 71*(4), 24–29.

Gikandi, W. J., Morrow, D., & Davis, E. N. (2011). Online formative assessment in higher education: A review of the literature. *Computers and Education, 57*(4), 2333–2351.

Gillette, J., & Gillette, L. (2015, February 16). *How to get your students to come to class prepared.* Retrieved from http://www.facultyfocus.com/articles/instructional-design/get-students-come-class-prepared/

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education, 30*(1), 30–43. doi:10.1080/00220480009596759.

McLaughlin, J. E., Roth, M. T., Glatt, D. M., Gharkholonarehe, N., Davidson, C. A., Griffin, L. M., Esserman, D. A., Mumper, R. J. (2014). The flipped classroom: A course redesign to foster learning and engagement in a health professions school. *Academic Medicine: Journal of the Association of American Medical Colleges, 89*(2), 236–243. doi:10.1097/ACM.0000000000000086

Medina, J. (2008). *Brain rules: 12 principles for surviving and thriving at work, home, and school*. Seattle, WA: Pear Press.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *The Psychological Review, 63*(2), 81–97.

Morrison, G. R., & Anglin, G. J. (2006). An instructional design approach for effective shovelware: Modifying materials for distance education. *Quarterly Review of Distance Education, 7*(757), 63–74.

Ruedlinger, B. (2012). *Does length matter? It does for video: 2K12 edition*. Retrieved from http://wistia.com/blog/does-length-matter-it-does-for-video-2k12-edition/.

Scriven, M. (1991). *Evaluation thesaurus* (4th ed.). Newbury Park, CA: Sage Publications.

Considerations When Evaluating the Classroom Flip Instructional Technique

Sarah E. Zappe and Thomas A. Litzinger

Abstract This chapter addresses the development of a strong formative evaluation piece—a necessity for strong course design. It discusses evaluating the impact that flipping has on teaching and student learning. The chapter also provides readers with an overview of a research-based approach to evaluation and describes what other sources of evidence might help one better understand the flipped classroom implementation. It concludes with concise summary of useful ideas and considerations, including ideas about making such research publishable.

Introduction

Evaluating instruction and its impact on student learning should be a central element of teaching practice. Evaluation is especially important when a teacher makes a substantial shift away from commonly expected teaching approaches, such as implementing a "flipped" classroom. Such a substantial change can lead to unexpected outcomes and pitfalls that need to be carefully monitored. Shifting away from commonplace teaching practice (e.g., lecture) can also lead to higher levels of anxiety for the teacher and students even though flipping the classroom provides flexibility in terms of what an instructor does inside the classroom and requires students to do outside the classroom.

Ultimately, the classroom flip is a framework that allows instructors to increase their use of evidence-based instructional practices[1] in the classroom (Means, Toyama, Murphy, Bakia, & Jones, 2009; Slavin, 2002), by freeing up time that had originally been allocated for lecture. Out-of-class time is no longer spent on homework; rather, students are asked to learn from instructional materials, such as online videos. The use of in-class time is dedicated to activities that are more active, constructive, or interactive in nature (Chi, 2009), allowing students to have increased engagement with the course material. Individual instructors' course plans may vary

[1] Instructional strategies whose efficacy is supported by research in education or psychology.

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substantially based on the course objectives and the nature of the discipline. However, regardless of the specific instructional practices implemented during class time, there are several common considerations for evaluation of all variations of implementations of the flipped classroom.

This chapter discusses key considerations for evaluating flipped courses. Based on our work evaluating flipped courses in the undergraduate engineering context, we provide various strategies for individuals who are beginning to consider how to evaluate a flipped classroom. Specific topics discussed in this chapter include: strategic course planning, formative and summative evaluation, using research-based approaches, and identifying sources of evidence. We include a discussion of the wide range of variables that may be examined when evaluating in-class and out-of-class activities.

Strategic Course Planning and Evaluation

According to the objectivist paradigm, when constructing a new course, whether taught in a lecture-based format or in a flipped format, the instructor should be strategic in course planning to ensure that elements of evaluation, instructional techniques, and curricular content all align. As Moffett (2015) notes in a discussion of best practices for flipped classes, "[c]ourse design decisions should, as ever, be based on sound educational theory and evidence-based practice" (p. 335). Design decisions are driven by learning objectives, as represented in Fig. 1. In the classroom flip, learning objectives should guide the selection of both in-class and out-of-class activities. In addition, using a strategic course planning process for course development will help to drive an appropriate evaluation plan aligned to all course elements.

Learning objectives should be developed as part of the first step of strategic course planning, in the objectivist approach. Several frameworks are available that can be used to help write course objectives. For example, Doran's (1981) SMART framework designates that objectives should be written to be specific, measurable, attainable, relevant, and time-bound. Objectives should be specific, or written in concrete terms regarding what a student should know or be able to do after completing the course or course unit. Objectives should be measurable, in order to determine whether the student has accomplished them. Objectives should be attainable, meaning that they can realistically be accomplished upon completion of the course. They should be relevant to overall course or program goals. Finally, objectives should be time-bound or able to be completed within a specified time range.

In the constructivist paradigm, a less strict approach would be used in course planning. The constructivist teacher would likely not have objectives written as specifically as in the objectivist approach. Instead, more generalized goals would be written which would be used to guide creation of online materials. While many of the out-of-class materials and activities would likely be developed in advance and aligned to general course goals, in-class activities may vary depending on the needs and abilities of the learners. Evaluation may focus on whether the general

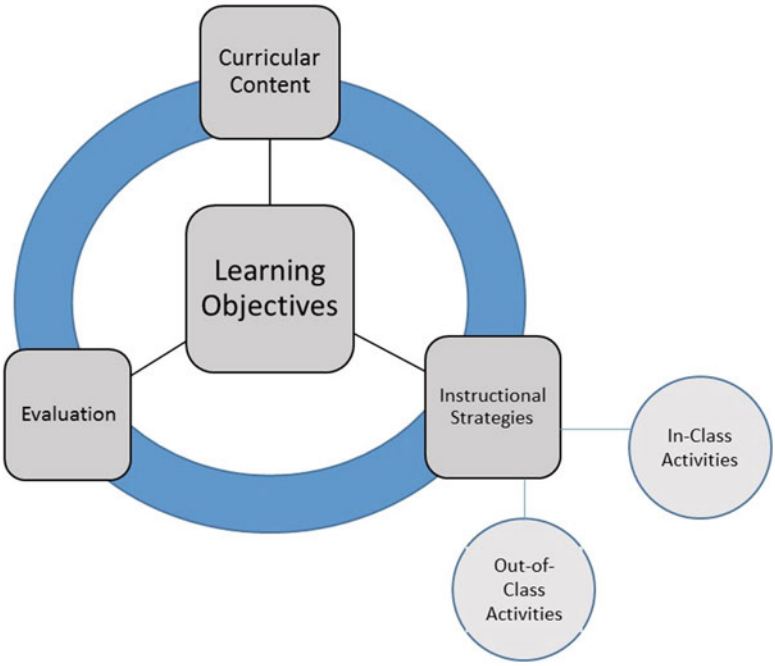

Fig. 1 Choices made in a course aligned to learning objectives

goals are being met, but would also take into consideration any unintended impacts of the learning experience.

Formative and Summative Evaluation of Flipped Classes

Educational evaluation is typically conducted for two purposes: formative and summative. Formative evaluation consists of collecting data for the purposes of improving instruction or student learning. In contrast to formative evaluation, the purpose of summative evaluation is to draw conclusions about the impact of the instructional method, focusing not on improvement but rather on making conclusive statements about instructional effectiveness. For many instructors of a flipped class, both formative and summative evaluation will be important as they want to identify areas for improvement but also to have a measure of the overall success or impact of the course.

The emphasis in formative evaluation is to identify potential problems and concerns and to make adjustments to better meet the students' needs in the classroom and enhance their potential to learn. These adjustments may be changes to instructor behavior or could be suggestions for students on how to be more successful in the course. From the student perspective, formative evaluation will improve student learning experiences and enhance his or her ability to learn the material.

Formative evaluation is particularly important when implementing the classroom flip because the classroom environment may be substantially different than what students are accustomed to. Formative evaluation will help instructors to fend off problems before they become unmanageable or have major adverse effects on students' attitudes toward the classroom flip instructional approach.

Formative evaluation can also provide data for students that enable them to think about the learning strategies and situations that work best for them. Formative evaluation helps students to "gain a better understanding of the goals of education, stimulating them to think more metacognitively about their own learning, motivating them to continue learning, and encouraging them to accept responsibility for their learning" (McKeachie, 2007, p. 468). For example, asking students about their perceived understanding may have them realize what they know or do not know about given course topics or perhaps think about the value that certain instructional strategies have for their learning.

While learning objectives should be central in the development of an evaluation plan for a flipped course, instructors may also want to consider using an evaluation framework to help identify possible evaluation strategies. Kirkpatrick's evaluation model (Kirkpatrick & Kirkpatrick, 2006) is one example that can be helpful in this aspect. The model consists of four levels to guide evaluation. The first level is reaction, or students' perceptions of the flipped course, including in-class and out-of-class activities. The second level is learning or what impact the flipped course has on students' acquisition of knowledge, skills, and abilities. The third level consists of application of students' learning to other environments, such as later courses. The final level is results or how students' behaviors change the overall institution, such as impacts on retention rates. Most often, course evaluators focus on students' reactions and learning acquisition. However, the level of evaluation of the flipped class might depend on the course context and how it is situated within an overall program. Using a model such as Kirkpatrick's can be helpful in determining the overall focus of the evaluation and in selecting the types of tools to use.

Using Evaluation to Understand Your Students

One purpose of formative evaluation is to gather data that allows instructors to adjust their approach based on the characteristics and needs of students. Because students with certain characteristics might experience special challenges with the classroom flip, collecting data at the start of the semester is especially important in this context. The first column of Table 1 contains a list of some of the student characteristics that instructors or evaluators may want to consider in a pre-course survey for a flipped course. This is not intended to be an exhaustive list, as other demographics may be important based on the context of the course, program, or institution.

Despite its increasing popularity, the classroom flip technique is still relatively new to most students. Some students may enter the classroom unsure what to expect with the method and, as a result, may experience high levels of anxiety.

Table 1 Considerations for variables to measure when evaluating flipped classrooms relating to student characteristics, out-of-class activities, and in-class activities

Student characteristics	Out-of-class activities	In-class activities
• Gender • Auditory, visual, learning, and other disabilities • Socioeconomic status • Cultural expectations • English as a Second Language • Previous relevant experiences • Concerns regarding new instructional strategy • Concerns regarding technology requirements • Prior knowledge of course material	• Alignment to course learning objectives • Alignment with related in-class activities • Clarity of materials • Accessibility • Technical issues • Appropriate amount of material assigned • Students' actual or estimated usage of online material (if applicable) • Students' level of preparation for related in-class activities • Student learning gains	• Alignment to course learning objectives • Alignment with related out-of-class activities • Clarity of instructions/materials • Level of engagement • Targeted time vs. actual time required • Generation of discussion/ questions • Perceptions of class environment • Perceptions of activity effectiveness • Student learning gains

Some students may conclude that the classroom flip requires "self-teaching" (Velegol, Zappe, & Mahone, 2015, p. 21). A pre-course survey can be used to ask students about their concerns for the course. Instructors then can use this information to assuage fears during the first few sessions.

Other information that should be gathered prior to the start of the course relates to students' socioeconomic status (SES). While instructors would not necessarily want to ask about students' family incomes for the sake of privacy, they may want to ask about computer and Internet access required for completing out-of-class activities. While most campuses have computer labs that would allow students to access the Internet, instructors must be cognizant that students with lower SES may have a greater difficulty accessing and using out-of-class materials. Demographics relating to SES and early exposure to technology may have an impact on the comfort and usage of technology in young adults (Ching, Basham, & Jang, 2005). More recently, it has been suggested that lower income families do have access to technology, although the type of access may vary, with more focus on smart phones for Internet access (Strover, 2014). These variables should be considered when requiring students in a course to access and use online technologies, particularly if online activities do not function as well on mobile Internet devices such as cell phones.

Students with auditory or visual disabilities could also face specific challenges with the classroom flip regarding access to out-of-class materials (Edmonds, 2004; Keeler & Horney, 2007). A good practice for instructors who use instructional videos as part of out-of-class requirements is to have transcriptions of the video content. These transcriptions could also be beneficial to students who are English language learners or who have other disabilities such as attention-deficit hyperactivity disorder. If other types of online, interactive exercises are a requirement for out-of-class time,

instructors will need to think of an alternative assignment that provides similar benefits to students who have disabilities that do not allow them to engage the standard assignment. While some universities may provide information regarding the students who have specific disabilities and recommend accommodations, instructors should specifically ask students to inform them of any disability or personal characteristics that might impact a student's ability to be successful in the course.

Evaluation of In-Class and Out-of-Class Activities

The structure of the classroom flip requires evaluators to be concerned with both in-class and out-of-class activities. The second and third columns of Table 1 display some of the possible types of data that can be collected to assess the quality and impact of both in- and out-of-class activities (summative evaluation) and how these activities can be changed or improved (formative evaluation). Examples of some of these variables are discussed further below.

In a qualitative study of faculty perceptions of the classroom flip, Zappe, Litzinger, and Yan (2015) discovered that some instructors tend to feel it is difficult to find or develop high-quality relevant materials that are appropriate for their course. Whether or not the instructor creates his or her own activities or uses texts, simulations, or videos that have been developed by others, evaluation should consider the effectiveness of the out-of-class activities relative to course objectives and if these activities need to be changed. In addition, it is critical to the success of classroom flip that the out-of-class materials should align with the instructional activities implemented during class time.

Other aspects of the evaluation of the out-of-class materials concern the nature of the materials and the assignments for students. Do students find the materials to be clear and understandable? Are students able to access the materials or do they have technical issues? Do students with disabilities have difficulty accessing or using the materials? For all students, it is important to determine whether students are devoting an appropriate amount of time to completing out of class assignments. As Moffett (2015) notes, "With a flipped classroom approach, educators can encounter the risk of 'dumping' content into an online learning environment, resulting in information overload for students" (p. 332). Asking the students how much time they spend outside of class accessing the materials can provide insight as to whether or not the assigned workload is appropriate.

Mid-course evaluations are very important when making changes in pedagogical approaches, especially one that may demand new behaviors from students. Mid-course, and end-of-course evaluation, in flipped classes should also ask students to provide information on whether they are accessing the out-of-class materials, how long they spend with the materials, if they access the materials more than once, and what portions of the materials that they found to be most helpful. Some online course management systems will provide exact data on the number of views for online videos or materials. However, this data are typically disaggregated and do

not allow researchers to examine relationships between an individuals' use of course material and other constructs, such as perceived understanding. Kay and Kletskin (2012) tracked the number of visits to online video podcasts required in a course and also asked students to estimate the number of time they visited the materials. Similarly, Velegol et al. (2015) collected data on how students interacted with online lectures by asking students how many videos they watched, how often they reviewed the videos, and the reasons they reviewed the videos.

In addition to asking students specific questions about out-of-class activities, evaluators should assess the effectiveness of in-class activities and whether the activities are achieving the desired cognitive and affective objectives. As with out-of-class activities, instructors will likely be concerned with whether or not the in-class activities align with learning objectives and other course elements. Other considerations are similar to the evaluation of out-of-class activities and include clarity, perceptions of effectiveness, and learning gains.

Using a Research-Based Approach for Evaluation

Using a research-based approach in developing an evaluation plan can be helpful in identifying impacts of a course that reach beyond student reactions or learning gains. Tenets of action research which focuses on investigations in "specific situations and localized settings" (Stringer, 2013, p. 1) are appropriate for better understanding the impact of the classroom flip on students and instructors as well as identifying best practices. The basic action research methodology, according to Stringer, is to look at a situation by gathering and describing data, think about the situation by exploring and analyzing what is happening, and then act by planning, implementing, or evaluating the situation. Often times in action research, the researcher is participatory and may be the course instructor.

Litzinger et al. (2011) describe a research-based approach in identifying guiding questions to help develop evaluation plans. These guiding questions relate to six general steps, intended to be part of an iterative evaluation process : (1) Specify program/course goals, (2) Consider stake-holders, (3) Develop hypotheses, (4) Identify sources of evidence, (5) Develop an evaluation design, and (6) Collect, analyze, and interpret data. By identifying hypotheses to be explored, evaluators can move beyond examination of "what works" to exploring deeper research questions, such as the impacts of the classroom flip on constructs such as student motivation or metacognitive skills.

When developing a research-based evaluation plan, robust research designs should be considered whenever possible. Bishop and Verlerger (2013) reviewed over 20 studies of flipped classes and found that most used a single-group design, with no comparison or control group. The authors noted that, "…future research on the flipped classroom should employ controlled studies that objectively examine student performance throughout a semester" and use direct measures of student learning such as concept inventories (p. 12). While a controlled study with random

assignment is typically considered the "gold standard" in educational and psychological research, having a control group is difficult in classroom based research, as random assignment is not typically practical in the college setting. Finding an appropriate comparison group also may not always possible, given logistical constraints. Many potential confounding variables can also emerge, which could be difficult or impossible to eliminate. Even simple variables such as the time of day when course sections are offered could potentially impact results of an evaluation. That being said, in the literature, a few studies were found that used comparison groups to compare traditionally taught courses to the flipped classroom. For example, Tune, Sturek, and Basile (2013) compared a traditional taught graduate-level course to a flipped course which was similar in terms of content and evaluation.

Another option is to compare data from multiple semesters, tracking student performance in non-flipped versus flipped classrooms. Zappe, Leicht, Messner, and Litzinger (2009) compared data on exam grades from multiple semesters in order to see if the change to the flipped classroom impacted student learning. Another evaluation design consists of collecting data at multiple time points to examine changes in constructs over a period of time. For example, Moraros, Islam, Yu, Banow, and Schindelka (2015) collected survey data at three time points during a semester in order to compare student perceptions of constructs such as their learning, instructor enthusiasm, and interactions with other students. Although a comparison group was not utilized, Moraors and coauthors were able to examine how student perceptions matched expectations and whether perceptions remained constant over time.

Strayer (2012) conducted research in his own course to examine the impact of a flipped course on students' perceptions of the classroom environment, including elements of cooperation, innovation, and task orientation. As Strayer notes, being both the teacher and the researcher has some limitations including the introduction of potential bias. However, by being an active participant in the research project, Strayer was able to investigate a research question that was of interest to him and helpful to the community of researchers and instructors interested in the flipped classroom. In their study on the impact of the classroom flip in an environmental engineering course, Velegol et al. (2015) also conducted action research, as Velegol was the instructor of the course examined. Bias was reduced in the study by having an external evaluator design evaluation tools and analyze and interpret the data. However, the instructor was highly involved in determining the research questions and guiding the evaluation process.

Thinking Beyond Surveys: Other Sources of Evidence

Along with identifying a robust evaluation design, evaluators need to identify sources of evidence which should (1) provide information on whether the course is meeting intended objectives, (2) provide information on what changes should be made to improve the course, and/or (3) be able to support or refute the specified research hypotheses.

Evaluators of the flipped classroom are encouraged to consider sources of evidence beyond surveys, which tend to be most frequently used in studies of classroom flip, as noted by Bishop and Verlerger (2013), who advocate for using more direct measures in future research. While surveys can yield helpful information, they are somewhat limited in that they rely on student perceptions rather than on direct measures of learning.

Spurlin, Rajala, and Lavelle (2008) provide a comprehensive list of other forms of assessment measures including information on their pros and cons. Direct measures of student performance include artifacts of student learning and are often (although not always) embedded into actual classroom assessment. Examples of direct measures include results of tests or rubrics used to score projects, presentations, or portfolios. Indirect measures rely on student perceptions of learning and include surveys, focus groups, or interviews.

Direct measures are generally considered superior to indirect measures for evaluation of student learning, as indirect measures rely on student perceptions, which may not be accurate. Instructors who wish to evaluate their own courses may want to use embedded assessment, or data from class assignments and exams that are part of regular course assignments, an approach taken in multiple studies of the flipped classroom (e.g., Leicht, Zappe, Messner, & Litzinger, 2012; Moffett & Mill, 2014; Tune et al., 2013; Zappe et al., 2009). Embedded assessment measures have advantages including the fact that they are direct measures of student learning, hopefully aligned to course learning objectives, on which students are generally motivated to do well.

While surveys tend to be overused, other less frequently used, qualitative measures can provide insight into difficult to evaluate constructs and provide richer responses from students. Focus groups, in particular, can yield rich information about the classroom setting and how it can be improved. For example, Galway, Corbett, Takaro, Tairyan, and Frank (2014) used focus groups in a flipped environmental and occupational health course to identify factors influencing the students' learning experience and changes in attitudes towards the subject area. Student or instructor interviews can also yield valuable information about the course. The disadvantage of these methods, compared to surveys, is the time-consuming nature of both data collection and analysis.

Tips for Conducting an Evaluation

When developing an evaluation plan, it is important not to get trapped in the planning phase by trying to design the perfect plan. Also it important not to try to measure everything that might be of interest; limited time and resources will require prioritization of the goals for the evaluation. Be cognizant of survey fatigue; it is easy to create long surveys that result in unusable data because students stop giving thoughtful responses. One way to reduce the length of surveys is to take advantage of existing data such as student demographic information that is available in institutional databases. Pilot-testing developed surveys with a small sample of students can

provide useful information, including whether the items are understandable and whether the resultant data can be easily analyzed. When possible, use existing instruments focusing on those that have strong validity and reliability evidence for their intended use. Identify instruments in the literature that have already been used to evaluate flipped courses to see if they can be used or adapted for your context. To find appropriate instruments, literature searches in databases such as PsycINFO or contacting authors of pertinent articles may be helpful. Embedded course assessments can also be used to provide information about the impact of the flipped classroom.

Research on the impact of the flipped classroom is still somewhat limited, although ever growing as the use of the method continues to increase. If one is considering publishing results of an evaluation of the flipped classroom, explore what journals are likely to publish action research. Often times, discipline specific journals, such as *Advances in Engineering Education* or *Advanced Physiological Education*, will publish applied research. Discipline specific academic conferences often have an education track, which is another place to publish action research on the classroom flip. Exploring deeper constructs such as the impact on classroom environment or student motivation may open up other alternatives for publication, such as Strayer's (2012) article which appeared in *Learning Environments Research*. Of course, if considering conducting research in the classroom, one must first obtain approval from the Institutional Review Board of one's college or university.

Evaluation of the flipped classroom follows the same strategies as evaluating any other type of instructional setting. This chapter provides suggestions on various factors that evaluators may want to consider when developing an evaluation plan for a flipped course. Evaluators should be concerned with the alignment of the course activities, both in-class and out-of-class, to course learning objectives. They need to be aware of how student characteristics can affect what students can gain from the course. Evaluators need to be concerned with both summative and formative aspects of evaluation to both identify areas where change is necessary and to understand what benefits students gain from the course.

Keywords and Definitions

- Formative evaluation—evaluation focused on improvement
- Summative evaluation—evaluation focused on drawing conclusions or judgments
- Action research—research focused on improvement often conducted by practitioners (i.e., course instructors) who want to understand their own practices
- Embedded assessment—data from required course assignments, activities, quizzes, and tests
- Direct measures—assessments that produce evidence of learning, e.g., quizzes or tests
- Indirect measures—assessments based on perceptions of value or depth of learning

Discussion Questions

- For your personal context, what are the most important characteristics that will affect student success in a flipped class and how can you evaluate those characteristics?
- How can you engage with a community of practice focused on evaluation of classroom flip? Could you become the center of such a community of practice?
- How will you disseminate what you learn through your evaluation to help your peers and your institution?

About the Authors

Dr. Sarah Zappe is Senior Research Associate and Director of Assessment and Instructional Support in the Leonhard Center for the Enhancement of Engineering Education at Penn State. In her role in the Center, Zappe works with faculty on improving and assessing educational innovations. She has worked with multiple faculty who have used the classroom flip in their courses; several of these projects have led to publications. Zappe has worked as evaluator on many National Science Foundation grants, including one assessing a new flipped course in nanotechnology. She currently is conducting a study of faculty perceptions of the classroom flip, including perceived challenges and benefits of the method.

Dr. Thomas A. Litzinger is Assistant Dean for Educational Innovation and Accreditation, and a Professor of Mechanical Engineering at Penn State. His work in engineering education involves curricular reform, teaching and learning innovations, assessment, and faculty development. Dr. Litzinger has more than 50 publications related to engineering education including lead authorship of an invited article in the 100th Anniversary issue of JEE on the development of expertise and for an invited chapter on translation of research to practice for the first edition of the Cambridge Handbook of Engineering Education Research. He serves as an Associate Editor for Advances in Engineering Education. He was selected as a Fellow of American Society for Engineering Education in 2008 and of American Society of Mechanical Engineers in 2012.

References

Bishop, J. L., & Verlerger, M. A. (2013). The flipped classroom: A survey of the research. Proceedings from ASEE 2013: *Annual Conference of the American Society for Engineering Education.* Atlanta, GA.

Chi, M. T. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science, 1*(1), 73–105.

Ching, C. C., Basham, J. D., & Jang, E. (2005). The legacy of the digital divide: Gender, socioeconomic status, and early exposure as predictors of full-spectrum technology use among young adults. *Urban Education, 40*(4), 394–411.

Doran, G. T. (1981). There's a S.M.A.R.T. way to write management's goals and objectives. *Management Review, 70*(11), 35–36.

Edmonds, C. D. (2004). Providing access to students with disabilities in online distance education: Legal and technical concerns for higher education. *The American Journal of Distance Education, 18*(1), 51–62.

Galway, L. P., Corbett, K. K., Takaro, T. K., Tairyan, K., & Frank, E. (2014). A novel integration of online and flipped classroom instructional models in public health higher education. *BioMed Central Medical Education, 14*, 181.

Kay, R., & Kletskin, I. (2012). Evaluating the use of problem-based video podcasts to teach mathematics in higher education. *Computers & Education, 59*(2), 619–627.

Keeler, C. G., & Horney, M. (2007). Online course designs: Are special needs being met? *American Journal of Distance Education, 21*(2), 61–75.

Kirkpatrick, D. L., & Kirkpatrick, J. L. (2006). *Evaluating training programs* (3rd ed.). San Francisco, CA: Barrett-Koehler Publishers.

Leicht, R., Zappe, S. E., Messner, J., & Litzinger, T. (2012). Employing the classroom flip to move "lecture" out of the classroom. *Journal of Applications and Practices in Engineering Education, 3*(1), 19–31.

Litzinger, T., Zappe, S., Van Meter, P., Borrego, M., Froyd, J., Newstetter, W., et al. (2011). *Writing effective evaluation and dissemination/diffusion plans: Guiding questions to help you get started*. Retrieved from http://evaluationanddissemination.weebly.com/full-report.html.

McKeachie, W. J. (2007). Good teaching makes a difference – and we know what it is. In R. P. Perry & J. C. Smart (Eds.), *The scholarship of teaching and learning in higher education: An evidence-based practice* (pp. 457–474). New York, NY: Agathon Press.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. Retrieved from https://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf.

Moffett, J. (2015). Twelve tips for "flipping" the classroom. *Medical Teacher, 37*(4), 331–336.

Moffett, J., & Mill, A. C. (2014). Evaluation of the flipped classroom approach in a veterinary professional skills course. *Advances in Medical Education and Practice, 5*, 415–425.

Moraros, J., Islam, A., Yu, S., Banow, R., & Schindelka, B. (2015). Flipping for success: Evaluating the effectiveness of a novel teaching approach in a graduate level setting. *BioMed Central Medical Education, 15*, 27.

Slavin, R. E. (2002). Evidence-based educational policies: Transforming educational practice and research. *Educational Researcher, 31*(7), 15–21.

Spurlin, J. E., Rajala, S. A., & Lavelle, J. P. (2008). Assessing student learning: Ensuring undergraduates are learning what we want them to learn. In J. E. Spurlin, S. A. Rajala, & J. P. Lavelle (Eds.), *Designing better engineering education through assessment* (pp. 24–58). Sterling, VA: Stylus Publishing.

Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation, and task orientation. *Learning Environment Research, 15*, 171–193.

Strover, S. (2014). The US digital divide: A call for a new philosophy. *Critical Studies in Media Communication, 31*(2), 114–122.

Stringer, E. T. (2013). *Action research*. Thousand Oaks, CA: Sage Publications.

Tune, J. D., Sturek, M., & Basile, D. P. (2013). Flipped classroom model improves graduate student performance in cardiovascular, respiratory, and renal physiology. *Advances in Physiological Education, 37*, 316–320.

Velegol, S. B., Zappe, S., & Mahone, E. (2015). The evolution of a flipped classroom: Evidence-based recommendations. *Advances in Engineering Education, 5*(1), 1–37.

Zappe, S. E., Leicht, R., Messner, J., & Litzinger, T. (2009). "Flipping" the classroom to explore active learning in a large undergraduate course. Proceedings from ASEE 2009: *Annual Conference of the American Society for Engineering Education.* Austin, TX.

Zappe, S. E., Litzinger, T., & Yan, Y. (2015). A qualitative study of instructor perceptions of the classroom flip. Proceedings of REES, 2015: *Biannual Conference of the Research in Engineering Education Symposium.* Dublin, Ireland.

Part II
The Flipped College Classroom: Case Studies

Flipping the Humanities

Abstract This chapter contains case studies from the Humanities. Case study authors indicate their course design was influenced by Paulo Freire's concept of problem-posing teaching and praise the use of team-based learning as a means to shift from merely providing content in a lecture-oriented classroom to designing and managing a lab or workshop setting. Each case study opens with the instructional context and a rationale for flipping the classroom. The case study authors also describe the structure of the course, as well as descriptions about how they prepared their students for flipping, and an evaluation of the flipping experience from both the instructor and student perspectives.

A Case Study on a High-Enrollment Freshman Seminar

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Instructional Context

Course Name and Description

Intellectual Foundations (UF100) is a required first-year general education course designed to help students learn to think and work on a college level. Each section has its own theme and is team-taught by two full-time faculty in collaboration with several discussion group leaders. Students meet twice a week: once in a plenary session of 225 students and once in a discussion group of 25. Our section's theme is the history and future of higher education.

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Place of Course in Larger Program of Study

UF100 is the first in a series of Foundational Studies courses required for all students. The first two courses, UF100 and 200, are interdisciplinary. The upper-division courses are discipline-specific and taught within university departments.

Learning Goals of the Course

The learning outcomes of all sections of UF100, regardless of theme, are the same:

- Engage in critical inquiry
- Communicate effectively in speech
- Create innovative solutions to complex problems by addressing them as part of a team
- Learn about historical theories and models of education
- Investigate current trends in higher education
- Imagine the future of universities

Description of the Learners

Our students range from traditional freshmen just out of high school to non-traditional students from a variety of backgrounds. Most are in their first year of university study. Many resist taking required classes outside their major, and they often enter our class unconvinced of its value, believing that they already have the critical thinking, oral communication, and teamwork skills they need. Most expect a passive learning experience, attending lectures and taking multiple-choice exams.

Rationale for Flipping

We created UF100 as a flipped class because we want students actively engaged. In an introductory course, especially one about effective education, we should model the best practices we discuss. Almost every class reading addresses the importance of active learning, so we could not very well stand and lecture.

Model and Theory Used to Guide the Flipping

Our course design was influenced by Paulo Freire's (2000) concept of problem-posing teaching, Salman Khan's (2011) TED Talk about Khan Academy, and many years of teaching first-year writing classes. *Make it Stick: The Science of Successful Learning* (Brown, Roediger, & McDaniel, 2014) is a recent influence.

Structure and Implementation

Structure of the Flipped Course

Our course has three major pieces: A weekly plenary class with 225 students, weekly discussion group classes of 25, and online work through Blackboard. The online activities are spaced throughout the week to prepare students for class time, allow them to build on their plenary and small group activities, and have them reflect on their learning.

Over the course of the semester, students work on individual and team assignments that build toward two team projects: a digital midterm presentation and persuasive final presentation.

The basic chronology of each week follows a standard pattern designed to move students from an initial encounter with the assigned reading, through dialogic activities meant to deepen their understanding of the text, and into an application and reflection of its major concepts:

Online reading quizzes due Mondays at 9:00 am. Quizzes are due before all discussion group meetings, so that students come to class familiar enough with the readings to begin to talk about them. Discussion group sections meet for 75 min on Mondays. Students spend 45–55 min on class activities and work for 20–30 min on team projects. Plenary class meets for 75 min on Wednesdays. Plenary balances whole-class discussion with small-group active learning and individual reflection. Online discussions are open all week, with initial threads due on Friday and responses due on Sunday. This pattern applies to most weeks of the course. We maintain consistent deadlines to help students schedule their time effectively.

Preparation of Learners for Participating in Flipped Instruction

We email a video tour of the online course site before classes begin and give students early access to the course readings and schedule. We outline the flipped structure of the class in the video, as well as in our first week's meetings. We point students to rubrics for discussions and assignments, as well as to samples of major projects, so that they are prepared to participate actively from the start.

Description of In-Class and Out-of-Class Activities

Out-of-class activities begin and end each week, making students accountable for the reading and their ideas about it. The following activities are required for the class:

- Quizzes: Students begin each week with an open-book, multiple-choice reading quiz on Blackboard, which they can retake once for a higher grade. Questions are randomized so that each attempt includes different information.

- Blackboard Discussions: The online discussion board forum for each week opens on Monday mornings, with students' initial posts due Friday night and their responses to classmates due Sunday night. The forums have guidelines for length and content, and each gives students a particular prompt to address by making specific connections between the class reading and their own experiences and observations.
- Online Resources: We created mini-lecture videos for each week where we model dialogic learning as we discuss the readings. We link to other supplemental resources so students can get different perspectives on the readings. We designed in-class activities to give students practice with the course goals of critical thinking, oral communication, and innovation and teamwork to deepen their understanding of the class readings and concepts.
- Discussion group sections: Discussion group leaders, following a suggested curriculum, ensure students understand the basics of each reading. They guide students through activities—drawing concept maps, creating mini-presentations on key ideas, comparing new texts with previously studied ones, etc. Students work on these activities in permanent teams of four to six. They also get "team time" each week in discussion group to prepare for major assignments.
- Plenary: Students attend the large plenary section, where nine discussion groups meet together with us, the lead faculty. Although the plenary meets in a lecture hall, we don't lecture (that's available online). We spend 10–15 min contextualizing and reviewing the readings, then spend the rest of the 75-min period on active learning. We engage students in a variety of activities, which have them often working in pairs or small groups, free writing, and sharing their ideas with the class. We use video clips and write extensively on the class whiteboards to help students synthesize the material and reflect on their learning.

Tools Used to Support the Flipped Process and Learners

Blackboard LMS serves as our "home room" and houses all class materials. Weekly electronic folders have a table of activities and deadlines on the outside, with links to quizzes, discussion forums, relevant assignments, our mini-lecture videos, and other resources on the inside.

Differentiation of Instruction

We address the varied needs of students in part by the range of resources we offer through the course site. Students can use our mini-lectures, websites, YouTube videos, and other resources to understand readings and engage with course concepts as extensively as they want.

We also offer personalized feedback through the online grade center, where we can evaluate students' participation and encourage them toward more critical

thinking and deeper engagement. We monitor performance and participation so we can intervene early to help struggling students.

Assessment of Student Learning

Assessment measures include quizzes, online discussions, team-based projects, and numerous individual reflections. We use rubrics for discussions and assignments throughout the course, so that grading is consistent across all discussion groups. We also involve students in assessment by having them give feedback on each other's presentations, evaluate their team members' contributions, and assess their own performance. We ask students for anonymous feedback at midterm and the end of the semester about their learning and experiences in the course.

Lessons Learned

The Instructional Experience

Flipping our class has taught us how to engage students more meaningfully in the course content. When lectures and assessments happen outside of class, students can take their time to process the material and say meaningful things about it. The quietest students in class are often the most outspoken and thoughtful in online discussion. Flipping also allows time in class for active learning. Students must participate in constructing knowledge; they cannot be passive either online or in class.

Out-of-class work can both prepare students for in-person meetings and help them synthesize their learning afterward. Initially, reading quizzes were due late Friday and discussion board posts due Wednesday, and we switched those deadlines because students were not prepared for class. Early quiz deadlines force students to read before class, and discussion boards that ask for higher-level thinking skills like synthesis and application are easier after students have processed the readings in class.

Students need class time for teamwork and must learn how to be effective team members. Providing class time, deliberately teaching teamwork skills, and scaffolding major projects shows students that we value teamwork, we know it takes time to learn, and we want them to have a positive team experience.

It takes two teachers to teach a high-enrollment flipped course well. We can take turns engaging with students and managing the class, leading discussion and observing classroom dynamics, creating resources and troubleshooting technology issues.

The Student Experience

Students are often initially uncomfortable with the level of responsibility a flipped class requires, but they improve quickly once they accept that responsibility. Many want texts explained to them before developing their own opinions, but as they use

our mini-lectures and online resources to grapple with difficult readings, they develop critical thinking skills that influence all their class work.

Through online discussion, students learn the value of other people's interpretations and methods of reading. They need encouragement to engage with the material and with each other, but our feedback (and repeated practice) helps them learn to use close reading and examples to express and expand their opinions.

Students can be resistant to active learning, which requires moving around the room, talking to others, putting away technology, and trying on viewpoints that differ from their own. But they come to see value in hearing others' viewpoints, getting to know each other, and applying course ideas to their lives.

A Case Study on International Studies

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Instructional Context

Course Name and Description

Contemporary Latin(o) Americas (CLA) is a second-year university Humanities undergraduate subject taught in English in the Faculty of Arts & Social Sciences at the University of Technology Sydney (UTS). It is specifically designed as a broad introduction to the combined study of US Latino peoples and Latin America.

Place of Course in Larger Program of Study

The course is a core subject within a BA International Studies degree (BAIS), along with "Foundations in International Studies," two years of Spanish language instruction, and a one-year period of In-Country Study (ICS). The BAIS is part of a dual-degree program combining International Studies with a vocational degree: Law, Business, Communication, Education, Health, Science, IT, Design.

Learning Goals of the Course

This course enables students to develop transferable analytical, evaluative and communicative skills and gain knowledge of important current theories, concepts and debates in relation to contemporary patterns of sociocultural change in the Latino Americas. The subject guides students in the acquisition of intercultural

competence as they creatively design and conduct independent research about Latin(o) American cultures, as well as reflect on their own learning processes through progressive, formative feedback on assignments and a reflective e-journal. Specific course learning objects enable students to:

- Describe and evaluate knowledge of the Contemporary Latin(o) Americas in their historical, political, cultural and social dimensions.
- Apply knowledge of key concepts and processes of social and cultural change in both independent and collaboratively designed intercultural research.
- Demonstrate critical problem-solving and research-led analytical skills.
- Communicate effectively the results of their research in English in an appropriate academic register.
- Follow good academic practice, including ethical practice and proper referencing procedures.
- Reflect upon and improve their own learning processes.

Description of the Learners

The class usually has from 35 to 45 learners who are third-year undergraduate students in the 20–22 year-old range from a variety of ethnic backgrounds and lacking specific background knowledge of the Latino Americas.

Rationale for Flipping

Student attendance was drastically declining towards the end of semester and student feedback surveys kept highlighting problems with the classroom dynamic: that it was too passive, that the tutor spoke too much, there were too many required readings, and that they had little space to experiment or demonstrate their creativity. These deficiencies were reflected in the student assignments, which tended to display a practice of memorizing and regurgitating content, and not the ability to develop one's own active and creative responses (transferring skills learned to new situations). In other words, surface learning was occurring, but not necessarily deep learning.

Model (s) and Theory (ies) Used to Guide the Flipping

This course was designed according to the theory of constructive alignment as well as other theories to do with student-centered learning, and complemented by peer and instructor formative feedback. It was also designed in the blended mode taking advantage of online learning technology with an instructional model which pushes engagement with new content outside the classroom and brings the homework into an environment of interactive, collaborative learning. I began with ideas from Aaron Sams and John Bergmann's well-known popularization of flipped learning,

and then progressed to two key texts: John Biggs' *Teaching for Quality Learning at University*, and Grant Wiggins and Jay McTighe's *Understanding by Design*.

Structure and Implementation

Structure of the Flipped Course

The subject has 12 weeks of classes, comprising a 45-min lecture for the first two weeks to establish trust and familiarity, and one weekly two-hour, face-to-face, interactive classroom session throughout the semester. The subject is delivered through a private WordPress blog (students are invited via UTS email). All pre-class learning materials are pre-loaded to the blog. Each week students access a mix of short video segments, PDF summaries of key concepts or big ideas, required journal article or book chapter readings, and some open education resources (OER). The main page of the blog has a link to outstanding work by previous students, links to Latin American newspapers, to useful study sites, and to blogs by the previous year's students on In-Country Study.

Preparation of Learners

The subject outline contains a brief description of flipped and blended learning, in which students are briefed on their responsibilities, especially as these relate to self-regulated and collaborative learning. This is repeated in the introductory "About this subject" video on the blog and in the first class. Detailed assignment description and marking rubrics are distributed before the start of semester through the subject outline and the teaching blog. These are then explained orally in class while showing successful assignments accessible to all on the teaching blog. I also get students in the first class to fill out short Q&A sheets on their expectations and anxieties.

Description of In-Class and Out-of-Class Activities

Out-of-class activities involve engaging with pre-class learning content, preparation for classroom activities by writing short, critical summaries of weekly content, background research for assignments, and peer evaluation of assignments. In-class activities: the first half of the class is dedicated to group work on key ideas and concepts, then open-class discussion, and other structured and semi-structured activities, such as scenario-based learning, problem-based learning and concept mappings. The second half is dedicated to self-directed, collaborative group work on assignments, including peer feedback on drafts, independent research, and presentation of final case studies to the class. I function as a catalyst and sounding board in class, calling

the activity changes, explaining complex concepts or processes when needed, and circulating around the room.

Tools Used to Support the Flipped Process and Learners

The main tools used are a teaching blog with links to YouTube videos and OERs. Students use PCs, laptops, tablets or smart phones to access the blog and do online research both in and out of class. The UTS learning management system (Blackboard) is employed for collation of marks and formal communication and a UTS-designed, Web-based assignment evaluation tool is used for giving formal feedback and grades to students. The tool also allows students to pre-evaluate their own performance before receiving the teacher's evaluation. My personal tools are a cheap LG laptop for in-class work and a home PC with a relatively cheap desktop camera and free software for video recording and editing. Students use digital platforms to deliver their group assignments and display their e-portfolios (WordPress, Wix, Prezzie, Tumblr, etc.).

Differentiation of Instruction

Instruction is differentiated by student choice of assignment topic and mode of assignment delivery, mode and frequency of group communication, and e-portfolio design. Since classroom activities are a combination of individual, group, or whole-class interactions, there is sufficient time for me to concentrate on individuals (or groups) who are struggling compared to the advanced ones. Students have the chance to negotiate the classroom activities with me—there is no rigid routine. Students also access online video content at their own pace and as many times as needed.

Assessment of Student Learning

The subject has four assessment tasks—three individual and one group, including: (1) a critical literature review; (2) a 4000-word group cultural case study, whose topic, design and mode of delivery is chosen by students; (3) a reflective e-learning journal; and (4) 10 weekly, half-page summaries of pre-class learning content. Assessment is both formative and summative. Students create a successful literature review in class and give feedback to each other's drafts via a cheat sheet prior to assignment submission. Students also present case study drafts to the whole class for peer and tutor oral feedback. Both these assignments have 20 % of the final mark allocated for student reflection on my assignment evaluation. Online learning content summaries are completed before coming to class and are allocated one percent of the final mark per week for 10 weekly. Learning journals are assessed for depth and quality of reflection on student's own learning processes.

Lessons Learned

The Instructional Experience

The main lessons I have learned from my flipped experiment are that most of the work with flipped learning is "front loading" materials to the digital teaching platform, including the short video lectures and designing a good bank of varied, engaging and well-planned group activities in detail so that I can step back, talk less, and trust students to run with it. You need to find the right rhythm and pace; so it pays to write out a detailed list of classroom activities and how much time to dedicate to each. The production of online lectures was problematic the first time around because I grossly underestimated the time needed and also over-estimated my personal skills. While my first video-making efforts were rough and ready, I subsequently discovered from online discussion forums on flipped learning, and from student reactions and comments, that slick videos are not necessary. Students are not that fussed, as long as they see in the videos the people they will meet in the classroom (i.e., keep OERs to a minimum). I also learned through student surveys that they do not like to have to regularly visit multiple sites for the course, so I just use two platforms: Blackboard and WordPress. I learned that no matter how well you explain flipped learning, students still need time to get accustomed to it (along with flexibility and freedom comes responsibility and accountability).

Group work requires carefully thought-out guidelines and explanation (and indeed reinforcement). The aversion to group work is often related to prior, bad experiences (free riders and/or vague or underwritten guidelines and marking rubrics). Scaffolding into complex cultural and political concepts needs careful consideration. Finally, pre-class and in-class accountability has to be built in. Getting students to engage in small, group activities from day one developed a sense of belonging in class and allocating a weekly mark for submitting summaries of pre-class learning materials provided a basis for interactivity. In the end, the main instructional experience was the joy of liberation from old ways of doing things. I began a reflective blog (https://testingflippedlearning2013.wordpress.com/) of that process in 2013, which still continues today.

The Student Experience

Students enjoy the flexibility and freedom of choice of topics, the teaching through a WordPress blog, the online lectures and working together. Sample survey comments:

- "I **really enjoyed the blog as a tool to provide the students with information. As a creative space, it encouraged my learning**"
- "The WordPress is a great way to communicate with students, it also encourages readings to be done as everything is laid out very clearly"
- "I really like the notion of online lectures as it means I control how much of the work I do, when I do it and how much in depth I do it. It makes it more enjoyable

to read the lecture notes on a Sunday night, knowing exactly what I'm going into on Monday morning"
- "I also think that it was good that **we were able to choose our own topics for the case studies and literature reviews"**
- "I enjoyed the variety of assessments task, **allowing to present critical analyses in a creative manner**. I also enjoyed the way lectures were set up with **active and thought provoking discussions rather than being spoon-fed information**"
- "I do think group work has merits. Also, I like that [teacher] encourages groups to work as a team; sharing information and mark peer-to-peer. This is a nice change"
- "The tutorials are not boring because as I mentioned earlier the freedom of the tutorial allows a far more enjoyable experience. And the group work at the end is great as well; we don't have to meet independently of that. Meeting with your group in class and communicating online is enough to complete the assignments effectively. #BigFan."

A Case Study on Medieval History

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Instructional Context

Course Name and Description

History 104: The Medieval World is a survey of global history from the fall of the Roman and Han empires to the European Renaissance. It is an entry-level course, and as such, focuses on basic historical literacy as well as disciplinary habits of mind rather than content mastery.

Place of Course in Larger Program of Study

The course is an option within Grant View University's (GVU) General Education Core Curriculum, the completion of which is required for all students. Its specific domain in our core is in "Questions of Faith and Meaning." The course thus has an emphasis on various philosophical and faith traditions of the medieval era.

Learning Goals of the Course

In addition to specific content, course goals address both GVU's Core (specifically, critical thinking, information literacy, and global awareness) and competencies

developed by team-based learning. The goals employ Fink's Taxonomy of Significant Learning Experiences (2013). By the end of the course, students will:

- understand and remember key themes, events, and people from this period of global history,
- develop the critical thinking skills necessary to meaningfully analyze historical material and arguments,
- achieve proficiency in academic writing, and
- develop the skills and aptitudes to be an important member of a successful team.

Description of Learners

As a 100-level Core course, most enrollees are first-year students across various majors and programs. This is, for many students, their first collegiate history course.

Rationale for Flipping

My course meets a core requirement ("Questions of Faith and Meeting") for which there are relatively few options for students. Due to demand, I raised the cap in my section from 25 to 40. My interest in team-based learning (TBL), a pedagogical strategy that moves away from the traditional, lecture- and content-driven approach of most history survey courses, caused me to rethink how I might be able to reach all the students effectively.

Models and Theories Used to Guide the Flipping

TBL gives students repeated opportunities to apply course concepts and material, primarily through in-class application exercises. My primary role as instructor shifts from merely providing content to designing and managing what is more of a lab or workshop than traditional, lecture-oriented class (Michaelsen, Knight, & Fink, 2004). Flipped learning is thus the foundation for TBL; without it, students will not be successful in the in-class applications—which are the heart of a TBL course.

Structure and Implementation

Structure of the Flipped Course

The course is organized into modules, each of which consists of a chapter in the textbook, additional primary source documents, and videos for students to view online. Students were required to have read the textbook chapter and source documents before the module's first class. Students read or view these materials on their own time, using their text and our campus's learning management system. Armed with this basic content knowledge, they are then ready to analyze, apply, and engage with the material in their teams during class.

Preparation of Learners for Participating in Flipped Instruction

I spend a good deal of time the first day of class explaining the TBL pedagogy to my students—what it is, and what it is not. We discuss particular strategies for success in the course, and I introduce them to flipped learning. I frame the pedagogy as a recipe for a more interesting and engaging course, an alternative to dreary passive lectures, but one that will only be successful if they take ownership of their out-of-class learning and are prepared for the in-class team applications. I emphasize the grading structure for the course and how their preparation outside of class plays a decisive role in the assessment of their learning. In the remainder of the first week of class, we organize the teams and run through a practice RAT sequence and application exercise. Students are primed for the higher-stakes work which begins the second week by already having had a chance to experience the course workflow and expectations.

Description of In-Class and Out-of-Class Activities

During a module's first class, students take a quiz on the basic content (TBL calls this a "Readiness Assurance Test," or RAT) individually. Then, they immediately take the same quiz together as a team, using a special scratch-off answer sheet that allows multiple attempts to find the correct answer. It's in the team conversations—where students discuss not only the "correct" answer, but the process by which they arrived at it—that high-level engagement with both course content and their peers takes place. Then, we have a class discussion where we work through any material where students still feel they need reinforcement. Subsequent class periods in the module are dedicated to application exercises. Each team is given a prompt or problem that they have to create a solution for, drawing upon the course material. In the last 10 min of the period, each team reports out, and we assess and critique as a class. The application exercises are graded, with each team member receiving the same grade. To prevent the "free rider" effect, students complete a peer assessment every two weeks, where they confidentially evaluate themselves and their peers; these assessments are equal an application exercise in grade weight.

Tools Used to Support the Flipped Process and Learners

Students use their textbook and the publisher's website for chapter and primary source document readings. We have a course page on Blackboard with links to any additional materials (such as the video streaming platform). I use a document camera and an interactive white board to capture each team's work, as well as notes generated by the whole-class discussion, which I then post on Blackboard. Students thus have access to the whole range of readings, discussion notes, and other teams' perspectives, enabling genuine peer instruction to occur.

Differentiation of Instruction

A primary benefit of the flipped approach to learning is the ability to present a variety of materials for my students online. Students read text, but they also have guiding questions to help them through the material. They look at images and perform visual analyses. They watch video material, including brief mini-lectures (<five min) introducing a module's topic and themes. The in-class applications are also varied in nature: students analyze documents; produce their own text; work with images; or construct their own pictures, timelines, or mind-maps. My goal is to have them engage with course material in as many different iterations as possible.

Assessment of Student Learning

The principal feature of this course's assessment is the preponderance of in-class work within the grading structure: roughly two-thirds of students' grades come from the in-class applications, self and peer assessments, and the RAT process. The variety of these activities allows me to assess both student learning at the basic content and metacognitive levels. Overall, I find the scope of assessments wider with a TBL course—the RAT process helps me gauge content mastery, but the other activities allow me to assess students' higher-order thinking in a variety of contexts.

Lessons Learned

The Instructional Experience

Flipping my class and implementing TBL have invigorated my approach to the survey course. Rather than a mindless slog through content, my classroom buzzes—it is active and alive, like a lab or workshop. I can circulate throughout the room, briefly joining each team and monitoring levels of collaboration and engagement. Rather than merely dispense content, I get to guide active learners as they construct their own knowledge of that content. Thus, when I do lecture (for no more than six to seven min at a time), I can aim it directly at where students need the additional scaffolding around the material. TBL also helps me model for my students that true scholarship is often collaborative, in the sense that it is a conversation with both sources and other scholars. Without flipping the class, there would be little to no class space for that modeling.

The Student Experience

I had expected some pushback about TBL, since the literature demonstrates that this is a common reaction to such a different pedagogy, but my students were nearly

unanimous in their positive reactions. When I asked about the impact the flipped model and TBL had on their learning, I got responses like:

- "I think [it] helped me learn more from other people. It's nice to have another point of view. I LOVED this class."
- "[TBL] helped develop my critical thinking in this area of study. My teammates also challenged me to be better."
- "It allowed me to see, hear, and understand the viewpoint of others and it helped me understand things when I needed help. It also helped teach cooperation and a lot of patience."
- "I think team based learning helped me more in this course because the material was harder to understand … without [TBL] I don't think I would have done as well in this class."

TBL helped students stay engaged because it was more active and hands-on. Moreover, many of them found the course material somewhat difficult and appreciated TBL's emphasis on collaborative learning. At the root of this semester's success was a successful "flip" of my class. By offloading content delivery and basic exposure to the material, I was able to successfully implement TBL in a course that benefited greatly from this pedagogical structure. The end result was a successful first run of a reinvigorated survey course and a model for flipping other survey-level courses.

A Case Study on Music Analysis

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Instructional Context

Course Name and Description

Advanced Analysis in Post-Tonal Music is a senior-level seminar in which students develop advanced analytical skills through close examination of the music of a specific composer. This flipped offering focused on a song cycle, *What are Years*, composed in 2009 by the American composer Elliott Carter.

Place of Course in Larger Program of Study

The course serves as one of the options for students to fulfill their requirement for upper-year credits in the area of music theory in the Bachelor of Music and Bachelor of Arts Honors music concentration programs.

Learning Goals of the Course

My primary objective is for students to acquire the confidence and technical skills to analyze unfamiliar post-tonal music in order to inform their performance, conducting or teaching activities, while also developing transferable skills such as critical thinking.

By the end of the course, students should be able to:

- Articulate common organizational features in Carter's music.
- Describe the process to follow when researching unfamiliar music.
- Apply relevant analytical tools to conduct original research into organization in post-tonal music.
- Integrate and select data to support an interpretation of a piece.
- Write about music using a style appropriate to theoretical analysis.
- Demonstrate the communication and collaboration skills needed for successful group work.

Description of the Learners

The majority of students are in their senior year of the Bachelor of Music program, while others are senior music concentrators in the B.A. Honors degree. All of them have completed two and half years of music theory and analysis.

Rationale for Flipping

I have taught the same course multiple times, but this is the first time I designed a flipped version. I wanted to bring the excitement of actively engaging in analysis right into the classroom, and to have all students attain a level of mastery through analysis as a process of communal discovery. In the traditional model, where class time was spent covering analytical approaches, and analysis was completed individually outside the class, students with weaker analytical skills often fell behind and were unable to assemble sufficiently rich analytical data on which to base a final interpretation.

Model (s) and Theory (ies) Used to Guide the Flipping

Drawing on constructivist theories, this flipped design focuses on active learning, particularly inquiry and discovery learning, guided by scaffolding. Based on team-based learning models, peer instruction is central: students work in assigned groups for the duration of the course and engage in peer evaluation. Foundational knowledge is acquired outside class, with application and problem solving happening in class.

Structure and Implementation

Structure of the Flipped Course

The course comprises a series of laddered in- and out-of-class activities that prepare students for their culminating activity: completing an individual analytical interpretation of a song, presented in essay format. Students gain the relevant background and develop the technical skills associated with analytical approaches in out-of-class activities. Weekly three-hour class sessions are devoted primarily to applying these skills and extending out-of-class learning through collaborative analysis of the music.

Each group works on a single song for the duration of the course, gradually gathering the data to support their final interpretation. After an introductory analysis of the poems (two weeks), students examine pitch structure (four weeks), then rhythmic structure (four weeks), and then revisit the poetic texts and learn how to synthesize these aspects into a text-music analysis (two weeks).

Preparation of Learners for Participating in Flipped Instruction

The purposeful design of the course is highlighted from the start. Prior to the start of classes I post a short podcast to introduce myself and to explain the flipped nature of the course and my rationale for the design. Student orientation continues in the first class. I describe to students how they will be expected to complete work independently between class meetings, emphasizing that these activities provide critical preparation for the in-class activities. Because of the importance of group work, I facilitate a discussion in which students identify the attributes that will enable them to contribute in a positive way towards group work, and to reflect on team responsibilities.

Description of In-Class and Out-of-Class Activities

Out-of-class activities are designed for students to acquire the background knowledge needed for their in-class application activities. For instance, students complete readings and take an online comprehension quiz prior to class. Using the quiz data, I start the next class by expanding on the areas in which most students experienced challenges. Group activities out of class usually involve preparing presentations, for example creating a composition to demonstrate Carter's rhythmic techniques and performing it in class.

The majority of classroom time is spent with students working in groups analyzing their piece from the particular perspective currently being studied, while I facilitate by listening, prompting, validating, and asking guiding questions. A small amount of class time is devoted to instruction to reinforce concepts or knowledge, as well as to group presentations (2), tests (2), and a jigsaw activity.

Tools Used to Support the Flipped Process and Learners (Including both Tech and Non-Tech)

The course website is a key tool, providing students with an overview of the course structure, details of in-class and out-of-class weekly activities, resources such as music scores, e-readings, recordings and videos, comprehension quizzes, and communication forums. Within the classroom, smart board technology plays a central role, with each group working at a round table with its own board on which their downloaded score is projected. Groups then annotate the score as they analyze it, using a stylus or their fingers.

In the first class I orient students to these tools through a group "scavenger hunt," which familiarizes them with the website structure and engages them collaboratively with the classroom technology in an unself-conscious and fun way. To connect with students between weekly classes, I send them a reflective communication a couple of days after class, and hold office hours.

Differentiation of Instruction

Instruction is differentiated in terms of the format in which students can access course content. For example, to learn about the characteristic ways in which Carter organizes pitch, they can either read an excerpt from a book or watch a video. In group activities students evolve their own ways of working effectively together and are free to determine their roles according their individual strengths and preferences: choosing to speak during group presentations, opting to manipulate classroom technology for the group, taking a leadership role, and so forth.

Assessment of Student Learning

In comparison to the traditional version, the flipped course includes both summative and formative assessment, and a mixture of group and individual assessments. I assign marks to all activities to signal the value of every component. Students are assessed in groups for the data gathered through analysis, and for presentations; they also complete peer evaluations of group work. Individual assessment includes in-class tests to demonstrate mastery of analytical approaches (marked in class for immediate feedback), online comprehension quizzes, formative writing assignments, and a culminating final essay worth 22 % of the course grade.

Lessons Learned

The Instructional Experience

This flipped class was one of the most rewarding teaching experiences I've had and exceeded my expectations. The group approach to analysis definitely raised the level of analytical insight and created greater parity between students, resulting in a high overall standard of final interpretation. One student's essay won the University's prize for the best music essay. Some aspects of my flipped format presented challenges that I will seek to address in future offerings: the focus on group work meant that there were few activities in which the whole class participated, and, because students were unaccustomed to group work, they needed more coaching than I had anticipated.

On a personal level, I felt liberated by not playing the role of "expert with all the answers," but rather applying my expertise in this field to guiding the students through the discovery process. The absence of a pronounced expert-novice dichotomy created better connections between the students and me, and facilitated informal interactions about important issues such as the relevance of music theory to the world, their career possibilities, and aspects of cultural sensitivity.

The Student Experience

Students were more engaged in the flipped version: attendance remained high throughout the term, students often stayed after the three hour had ended, and a few even brought friends to class on a couple of occasions. In a post-course survey, the course components that were most often cited as being valuable to their learning were group work, technology, and health breaks (15-min movement and nutrition breaks that were student led). The analysis of two videotaped classes identifies emergent themes that support the value of the group work and using in-class technology for group communication about the music.

In feedback, students mentioned how much they enjoyed doing primary research and being the first people to analyze these recent songs, and commented on the group work: "the group work aspect was very interesting and well implemented—it really allowed for the learning to be student-oriented as we learned through actually doing the work;" and on the course format: "I like the blended learning style in that it allowed more class time to work with our groups and ask questions instead of just being lectured at."

A Case Study on Theatre Appreciation

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Instructional Context

Course Name and Description

The Theatre Appreciation course is a large enrollment hybrid section (200–400 students) that meets "on the ground" in the campus's proscenium theatre once a week. All reading content, written assignments and quizzes are online, with the exception of three scripts that are read and discussed in class.

Place of Course in Larger Program of Study

As a general education requirement, all Middle Tennessee State University (MTSU) undergraduates must complete an appreciation course, choosing from Theatre, Music, or Visual Art. The Theatre Appreciation course is taught by tenured, tenure track, full-time temporary and adjunct professors in the theatre department.

Learning Goals of the Course

The learning goals are:

- Identify major theatre artistic movements and historical periods and to define major theatre genres, concepts, and terminologies.
- Describe and explain parts of the production process.
- Apply concepts of art to theatrical elements.
- Suggest critical standards for observing a live theatrical performance, evaluating effectiveness of a live play by comparing different stage productions as well as other forms of entertainment and artistic expression.

Description of the Learners

This course enrollment is typically composed of traditional (18–20-year-old), non-theatre major students in the first and second year of college.

Rationale for Flipping

As part of the university's initiative to improve student success and retention, this course was redesigned to promote student engagement, active learning, and discovery using interactive activities designed to increase student participation in the classroom and online. Another reason for the redesign was to promote theatre awareness and encourage students to consider theatre as an academic major.

Model and Theory Used to Guide the Flipping

We were inspired by the Bergmann and Sams (2012) flipped classroom model assuming that class time is better devoted to the implementation of collaborative and engaging activities than to the introduction of basic concepts. Students received more learning options and greater choice through revised modules and assignments in a "buffet strategy" to improve student success. Our goal was to make the course as "user" friendly as possible for students, regardless of size or delivery method. For example, the course provides content and activities for students with a preference for kinesthetic, audio or visual learning. Our underlying assumption was that students who are interested and engaged will be successful.

Structure and Implementation

Structure of the Flipped Course

Course content includes performance, dramatic structure and theatrical production elements presented through a variety of methodologies including presentations, live performances, and discussions. Our university provided funding for six student assistant theatre majors to assist the instructors and facilitate the small-group activities. The student assistants also participate in the creation and execution of in-class improvisation, facilitate discussions and encourage engagement, and perform scenes for the class.

In three outside-of-class study sessions, the student assistants provide direction and feedback for student-written responses to shows and a "New York Project." The latter project is a written assignment encouraging students to explore current shows on Broadway and Off-Broadway. Finally, the student assistants present stage readings of the three required scripts for the course. We also meet weekly with student assistants to create and prepare for in-class activities. The student assistants are therefore essential to the success of the flipped course.

Preparation of Learners for Participating in Flipped Instruction

At the beginning of the course, the instructors describe to students how the online component works, illustrate theatrical concepts through improvisation, and inform them that in-class time will be spent engaging in active learning. This approach prepares students for the remainder of the course, as each class employs active learning activities that directly relate to course content. Every class meeting is a mini-performance with appropriate lights and music. To set the stage for the course expectations, the instructors create a theatrical experience from the beginning.

In the online component, the homepage news notifies students that the course is organized similar to a play. Upon arrival for first face-to-face class day, students receive a personalized "ticket" and seat assignment in the theatre. Student assistants serve as ushers/entertainers employing improvisational skills as they "help" students to their seat. As students enter the theatre, stage lights and "pre-show" music set the mood. This approach encourages students to come to class and serves as another reminder to do their online work.

Description of In-Class and Out-of-Class Activities

The course redesign promoted student engagement, active learning, and discovery by incorporating several changes in the classroom and online. Throughout the term, instructors are referred to as Directors and student assistants as Stage Managers. Every active learning activity is guided by presentations that keep the student groups on task through information, timelines, and requirements. Outside of class, students read online content and write responses to required theatrical productions.

In class meetings, small groups work together on activities that connect to theatrical concepts studied online or to the productions viewed outside of class. For example, students read online content about different theatrical genres outside of class. Instead of lecturing on the online content, instructors conduct an in-class activity—"Genre Gameshow"—in which students first discuss genres in small groups called Casts. Then Stage Managers perform scenes from different genres and the groups identify the genres in the style of Jeopardy. This provides in class opportunity to "experience" the content that was studied online.

Tools Used to Support the Flipped Process and Learners

To reinforce theatre terminology, we edited the learning management system tools. For example, "Cast List" replaced "Class List," "Reviews" replaced "Grades," and "Playbill" replaced the "Content" tool. By reorganizing 10 content modules into eight, we streamlined the online content to allow students to spend more time on less material thereby increasing retention of content. Each course module (both in-class and online) is structured as "Prologue" (Weeks one to two), two-week "Acts I-VI" (Weeks three to fourteen) and the "Finale" (Week 15). Online material is sequenced giving students access to the materials in the following order: content,

warm-up, and quiz. Students are permitted to take biweekly Act quizzes an unlimited number of times, with their final grade being the average of all attempts. In the classroom, Directors and Stage Managers support the flipped process by facilitating active learning.

Differentiation of Instruction

Students first read about class content online. When they come to class, they are afforded the time to experience what they have already studied in an active way. For example, after studying the duties of the stage director online, students come to class and experience those duties in several small group activities. Students experience being onstage and following stage directions, they assign parts in a small scene and call out stage directions to one another, and, finally, they lead a rehearsal with fellow students. In this way, the online materials and in class activities are integrated in such a way to provide students with an enhanced understanding of the concept of directing.

Assessment of Student Learning

An assessment of student written critiques of live performances is conducted by external theatre instructors using a rubric aligned with state general education standards. This pre- and post-assessment of student critiques provides an evaluation of skills and competencies gained over the duration of the course.

In addition, students complete assessments over the course redesign, including information about knowledge and skills gained, rating active learning exercises, and overall evaluation of the course and instructors. In an open-ended format, they list theatrical concepts and terminology learned during the course.

Lessons Learned

The Instructional Experience

Instructors find the classroom experience to require more preparation than the previous lecture format but to be more rewarding. The prepared instructor is quite busy during class time but no longer in the "hot seat" as the focus is shifted to the students.

Engagement between students and instructors is enhanced through personal interaction with the Casts in class, online via email, and with clear evaluation rubrics that lead to successful student understanding of grading outcomes. By using fewer teaching modules and emphasizing live performances, students are more engaged with the content. Time for the face-to-face meetings is a challenge. We have learned that while it is necessary to be committed to a time schedule for in-class activities, the importance of flexibility cannot be overlooked when excitement, learning, and understanding of the content is in process.

The revised modules, learning styles assessment, assignments in a "buffet strategy" and unlimited attempts at quizzes are successful tools. In the pilot semester, assessed competency levels in the "analysis of a play as a form of cultural and visual expression" were increased 15 % from pretest to posttest. "Critical assessment of play interpretation" scores increased by 21 % and "Application of theatrical terminology and critical theory" scores increased by 19 %.

The employment of Stage Managers makes the use of Casts possible and is a vital part of our success. Students are more engaged when they are able to speak "one on one" with a leader and they enjoy seeing their Stage Managers perform outside class in the MTSU external theatrical productions.

The Student Experience

In the pilot semester, students identified aspects of learning found in all four learning goals. Of the students surveyed, 52 % felt they were now able to "apply theatrical terminology and theatrical critical theory." The survey revealed that 80 % of students indicated that "the course structure has helped me to be more successful in the course," 68 % of students indicated that the course "changed or affected my opinion of theatre as a profession," and 75 % of students were enthusiastic about the redesigned course. For example, the Cast exercises, listed as the fourth most popular item, included one student's response: "I learned how to work in a group. Before this class I was really shy and could not really connect with other people very well. In this class we are assigned a group that we have to figure out how to work with. That was my favorite part about this class. I got to work with people and be important for a little while." Theatre is a collaborative art form and this student's comment speaks to the heart of the discovery of how theatre art is created, with ideas shared through collaboration.

References

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Washington, DC: International Society for Technology in Education.

Brown, P. C., Roediger, H. L., III, & McDaniel, M. A. (2014). *Make it stick: The science of successful learning*. Cambridge, MA: UP Harvard/Belknap.

Fink, L. (2013). *Creating significant learning experiences: An integrated approach to designing college courses* (2nd ed.). San Francisco, CA: Jossey-Bass.

Freire, P. (2000). *Pedagogy of the oppressed*. New York, NY: Continuum.

Khan, S. (2011, March 9). *Salman Khan Talk at TED 2011* [Video file]. Retrieved from https://www.youtube.com/watch?v=gM95HHI4gLk

Michaelsen, L., Knight, A., & Fink, L. (Eds.). (2004). *Team-based learning: A transformative use of small groups in college teaching*. Sterling, VA: Stylus Publishing.

Flipping Education

Abstract This chapter contains case studies from Education. Case study authors discuss ways to reduce cognitive overload, as well as methods for differentiating the student flipped learning experience, assessing by process and not just product. Several cases address the application of the ADDIE model in a "constant cycle of design and evaluation." Each case study opens with the instructional context and a rationale for flipping the classroom. The case study authors also describe the structure of the course, as well as descriptions about how they prepared their students for flipping, and an evaluation of the flipping experience from both the instructor and student perspectives.

A Case Study on a Graduate-Level Educational Psychology Course

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Instructional Context

Course Name and Description

Psychological Foundations of Education is a doctoral level educational psychology course that introduces the major theories and theorists of educational psychology. The course provides an overview of how learning occurs, the factors that influence it, and how learning principles are applied in a variety of educational contexts.

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Educational Communications and Technology: Issues and Innovations,
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Place of Course in Larger Program of Study

The course is offered as part of an Ed. D. program, and is a required course for first-year students enrolled in the Learning & Instruction program. For students enrolled in one of the other Ed. D. programs offered in the School of Education, the course can be used to fulfill the Foundations Course requirement necessary to graduate.

Learning Goals of the Course

Some of the learning goals for the course include: (a) gaining knowledge of the major psychological theories that inform instruction; (b) developing students' ability to read and synthesize research; (c) becoming familiar with basic research methodologies; and (d) engaging in scholarly writing and further develop writing skills.

Description of the Learners

Students enrolled in the program are working professionals who are pursuing their Ed. D. degree. Students come from various programs and have more of a "practice" orientation than a "theoretical" orientation towards understanding educational issues. In this particular instance there were 23 students in total, with 15 students from Learning & Instruction, six students from Organization and Leadership and two students from International and Multicultural Education.

Rationale for Flipping

Classes in the Ed. D. program are offered on a *Teaching Weekend* schedule which consists of nine weekends (Friday night or Saturday daytime) during the semester. There is typically a two-week break between class sessions. Due to this class schedule, flipping made sense in terms of making the most efficient use of the limited face-to-face time I had with my students. I have taught this course multiple times, and have experimented with various forms of technology to enhance students' learning experiences. However, this was my first time using the flipped model throughout the entire course.

Model (s) and Theory (ies) Used to Guide the Flipping

There are two theories that guided my approach to flipping my classroom: cognitive load theory/multimedia learning literature and constructivism. With regard to cognitive load theory/multimedia learning literature—the pre-training principle (Mayer, 2005) suggests that by providing learners with some of the basic information ahead of time, you can reduce the cognitive overload that may occur while trying to

process complex information. I thought of the online video lectures as a form of "pre-training" for my students as the video lectures were meant to provide an overview of the theories being dealt with that week in the subsequent readings and discussions. Constructivism—the notion that learners are responsible for building their own understanding—also played a key role in guiding my use of the flipped classroom approach. The notion that knowledge is constructed by learners guided my decision to incorporate the use of online discussions and in-class activities that were meant to facilitate this process for my students.

Structure and Implementation

Structure of the Flipped Course

There were four primary components to the overall design/structure of this flipped course: (1) online video lectures (viewed prior to each class), (2) online discussions (to be completed prior to each class), (3) in-class activities (developed and led by the instructor), and (4) facilitation of in-class discussions (developed and led by students). Each face-to-face class session dealt with different major theorist/theories. Consequently, student learning in the course followed a typical pattern between face-to-face class sessions. Students were asked to first watch the online video lectures as an introduction and orientation to the concepts and theories to be discussed during the coming weeks. In addition, students read various textbook chapters and journal articles relevant to the topic, participated in online discussions (due the Wednesday before class) and then came to class to engage in activities (both student-led and instructor-led) meant to deepen their understanding of the theories and the application of these in various contexts.

Preparation of Learners for Participating in Flipped Instruction

Initial orientation to the tools and technologies that were to be used during the semester was given during the first class session. In addition, students received periodic feedback if they seemed to be struggling with any aspect of the course (e.g., online discussion postings). Finally, feedback was solicited from students at the midpoint of the semester to see what was working for them and what needed to be adjusted to facilitate their learning.

Description of In-Class and Out-of-Class Activities

During our face-to-face class sessions I used a number of different activities such as think–pair–share; small group discussions of research articles; and gallery walks for sharing out ideas. In addition, at the beginning of the semester, groups of three to four students signed up to lead their peers in a discussion and learning activity

during one class period. Students were asked to come up with creative ways to further help their peers (and themselves) understand the theories and ideas that were the focus for that class session.

As already discussed, prior to coming to class students were required to view the online video lectures, which served as an introduction to the concepts to be learned for that week. Then students engaged in additional readings and sometimes watched additional videos to further deepen their knowledge about the particular concepts. Afterwards, students engaged in online discussions with their peers about that week's topic. I provided the discussion prompts that students were to respond to, which most often followed the three-two-one format: "What are *three ideas* you took from the readings? Consider how these ideas relate to what you have observed in your professional practice. What are *two intriguing quotes* from the reading? Why do you find these quotes intriguing? Pose at least *one question* to the rest of the class to discuss here online." Finally, in addition to these learning activities students' final project was an action research paper in which they were to address an educational problem they had observed or experienced as a student in a classroom or informal learning environment.

Tools Used to Support the Flipped Process and Learners

Minimal tools were needed to create this flipped classroom. I primarily used *Keynote* to develop my presentation slides and record my lectures. I stored my lectures on *Vimeo*—where students could stream them seamlessly. I also used our university's course management system (*Canvas*) to host the online discussions, post readings, provide feedback and post student grades.

Differentiation of Instruction

As part of the flipped structure, students participated in online discussions prior to attending face-to-face class sessions. These online discussions were the primary way that instruction was differentiated for students, as they were encouraged to relate the ideas from the readings and lectures to their own professional practice.

Assessment of Student Learning

Assessment of student learning was not drastically different between the flipped iteration of this course and the non-flipped iteration since many of the key components of the course existed in both formats. Assessment in the flipped course included a mix of group and individual assessments. Students were assessed in groups for their development and facilitation of class discussion and learning activities. Individual assessment included pre-class online discussion posts, two personal theory-of-learning papers, an action research paper, and a poster presentation of their action research paper results.

Lessons Learned

The Instructional Experience

The flipped method worked well for this class, particularly given the class meeting schedule. The benefit of having students view the lecture and discuss their initial ideas online before coming to class allowed us to have more in-depth and meaningful conversations about the content. I believe students walked away from the course with a much deeper and nuanced understanding of the theories than would have been possible using a more traditional format, due to the extended activities and discussions we were able to have during class time. Based on feedback received, improvements I would like to make for future implementations include:

- Smaller online discussion groups
- Varying discussion prompts for online discussion forum
- Implement accountability system for the student-led discussion/activities
- Implement short comprehension quizzes into or after online video lectures

The Student Experience.

Based on an end-of-course survey (74 % response rate), students greatly valued the variety of ways in which they were able to engage with information (videos, readings, in-class activities, online discussions) in the course. One student commented:

> I think the combination is great, I am especially motivated by the online lecture videos and the in-class activities. The online discussions were a little intimidating at first, because I was not good at sharing my ideas openly. But later I was more used to it and I started to appreciate and reflect on different thoughts.

In addition, the majority of students found the various components of the course effective for understanding course content, a valuable use of time, and enjoyable.. See Table 1.

Table 1 Perceived effectiveness, value, and enjoyment of course components

	Effective for understanding? (very effective/effective)	Valuable use of time? (strongly agree/agree)	Enjoyable? (strongly agree/agree)
Video lectures	76 %	71 %	70 %
Online discussions	77 %	53 %	47 %
In-class activities	65 %	71 %	70 %
Facilitating in-class discussion	77 %	n/a	n/a

A Case Study on Introduction to Education

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Instructional Context

Course Name and Description

Introduction to Education is an undergraduate course that provides knowledge about, and critical analysis of, the development and structure of schooling and teaching in the United States. It explores teaching as a profession, school governance and finance, issues of practice, historical, socio-cultural, philosophical, political, and legal foundations of education, and current educational reform.

Place of Course in Larger Program of Study

The course is required for all undergraduate education majors. Most students take the course in the first year of the program as it is a prerequisite for other educational courses. Since it serves an important role in the program, the course is offered in both the fall and spring semesters.

Learning Goals of the Course

Student learning outcomes revolve around four themes. Expectations for the students include developing, analyzing, demonstrating, and articulating their understanding of the four themes as influential components of the teaching profession:

- Aims of Education and Role of Schools in a Democratic Society
- Economic, Legal and Political Contexts of Schools
- Culturally Responsive and Inclusive Education
- Ethics and Professionalization of Teaching

Description of the Learners

The *Introduction to Education* course consisted of 24 students: 20 were female, four were male, and the majority of the students were white. There were also students with physical and specific learning disabilities in the course. Most of the students were between the ages of 18 and 20, had part time jobs, and commuted to campus. Some students also had children of their own.

Rationale for Flipping

As a former K-12 educator, I often used individual and group activities in the classroom to provide opportunities for the students to engage with one another as they learned the content of the lesson. This practice also carried over into the college classroom, but due to time constraints, the practice paled in comparison. After attending a session on the flipped classroom, I decided to implement the approach in the *Introduction to Education* course, which I have taught eight times, in order to provide students with opportunities to become active in their own learning.

Model (s) and Theory (ies) Used to Guide the Flipping

In developing the course design using the flipped classroom approach, I relied on brain-based learning principles. Knowing the brain needs socialization, meaningful connections, and challenges, I implemented cooperative learning activities as well as individual activities to challenge the students' brains, while also scaffolding these experiences (Caine & Caine, 2006; Gulpinar, 2005; Jensen, 1998; Johnson, Johnson, & Holubec, 2008). Knowing the brain is unique and students may have different preferences of learning, I used a variety of modes to deliver instruction and for students to demonstrate their understanding of the content (Tomlinson, 2004).

Structure and Implementation

Structure of the Flipped Course

The course was scheduled to meet two times per week in the 16 week semester for one hour and 20 min each class meeting. There were four parts to the content: (1) learning about teachers and students; (2) learning about the foundations of education; (3) learning about the teaching process; and (4) learning about reforms and the

future of teaching. Outside assignments for students included readings, videos, and completion checks before the first class meeting of the week. I used a bell ringer or class ready activity at the beginning of the class to check for understanding of the content. For example, upon entering the class, students completed a writing prompt about the assigned readings. The class meetings would then consist of individual and group activities to reinforce the content of the week followed by an exit slip. Students completed online or in class quizzes throughout the semester in addition to exams and projects.

Preparation of Learners for Participating in Flipped Instruction

In order to prepare students for the flipped classroom approach, I used some of the techniques noted by McVay-Lynch (2001). I had the students compare and contrast online learning and face-to-face learning including both teacher and student roles. I also had the students take a learning preference survey; research the results; and create a plan that included strategies they believed would help them with the flipped classroom approach.

Description of In-Class and Out-of-Class Activities

The materials uploaded on Blackboard (the learning management system used) consisted of PowerPoint and Prezi presentations, articles, videos, and documents. Students also responded to discussion questions and thinking journal prompts based on the materials which served as checks for understanding. In-class activities based on assigned material gave the students opportunity to interact with each other to discuss, create, and share their knowledge. Activities included: radio broadcasts of historical events, role plays from different points of view, and song rewrites of content learned such as philosophies, drawings, and technology creations. The student groups would also share with the class and sometimes serve as the "experts" during a jigsaw activity using educational or historical articles.

Tools Used to Support the Flipped Process and Learners

Students prepared for the flipped classroom approach by going through the layout of Blackboard, the expectations of out-of-class assignments, and scaffolding the implementation of the approach. I also gave students the option to receive outside tutoring. Tutoring varied from helping students understand the content to giving examples of projects completed. During in-class activities, I would often meet with base groups to discuss group progress and answer any questions. Base groups consisted of four students who would meet to discuss content and activities before and after the lesson throughout the semester.

Differentiation of Instruction

Instruction outside of the classroom varied to meet individual preferences of students including visual and auditory presentations. During class, the students often had a choice of activities that were differentiated based on content, process, or product. Choice boards provided students with a choice of activities to complete following the rules for tic-tac-toe. Activities used varied in thinking levels, multiple intelligences, and learning preferences. Examples included choosing to rewrite a song about a particular educational philosophy; creating a "breaking news" radio script for another group to perform; and reading and analyzing an article to present in a method of their choice. In addition, I used different levels of reading content with students with exceptionalities, specifically reading disabilities.

Assessment of Student Learning

I provided bell ringers/class ready activities at the beginning of the class period to monitor the students' learning of material out of class. The bell ringers contained a question, scenario, or issue based on the assigned material. Students also received an exit slip to enable them to record what they had learned that day, what was still unclear, and what questions they still had about the material. I collected the exit slips as the students left the classroom. The responses helped to inform my follow-up assignments and lessons. I used journal responses, open discussions, and attainment of course outcomes to assess the flipped classroom approach. I had not included these types of assessment techniques in previously taught courses to this extent. With the flipped course approach, I relied on these assessments to serve as formative assessments. How students participated and responded to these formative assessments allowed me to see where I needed to spend more or less time on content in future lessons.

Lessons Learned

The Instructional Experience

Based on the information gathered through assignments, discussions, and observations, the flipped classroom approach appeared to be effective. However, there is always room for improvement. Changes in a subsequent course include the inclusion of more differentiated activities, pre-assessment, and compacting. From the pre-assessment, students demonstrating knowledge of the content to be covered will have outside work compacted into a shorter amount of time to enable them to learn more content at a deeper level. I also learned that some students are hesitant to use an online tool to learn content. They feel they will miss something important that I would express in a face-to-face setting. This places more responsibility on them to analyze and critically think about the content placed online. I will need to stress the importance of time management and resources available to them such as tutoring.

The Student Experience

From conversations with individual students and the class as a whole, the flipped experience was new to them and at first made them apprehensive. However, as the semester continued, they appreciated the opportunities to discuss the content, work in groups, and be creative with their learning. The students also indicated that they needed to work on their time management skills because they were used to having lectures and presentations "give" them the information. However, in the flipped approach, more responsibility is placed on them. In the end, they liked the flipped classroom mainly for the "great" activities.

A Case Study on Instructional Design in Teacher Education

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Instructional Context

Course Name and Description

Instructional Design is a first year foundation course, in which students learn the basics of how to develop a learning experience by designing one themselves. This is done by having the students apply the steps of an instructional design model to a practical case that they develop themselves.

Place of Course in Larger Program of Study

Instructional Design is a mandatory year one Foundation Course in the four year Bachelor of Education program. This program prepares students for teaching in primary, secondary, or adult learning institutions.

Learning Goals of the Course

At the end of the course the students should be able to use learning theories and instructional design models to design and develop educational modules and corresponding materials for use in their teaching practice.

Description of the Learners

The students are both pre- and in-service teachers, and all are over 16. Many students have substantial work experience, both in teaching and otherwise, while some, especially the younger students, have no work experience. In Trinidad and Tobago, the Ministry of Education licenses teachers. The minimum educational requirement is a Bachelor of Education degree for teachers at the primary school level (ages six to twelve). For secondary school (ages 12–18) teachers, a Bachelor degree in the subject to be taught (Maths, Physics, Art, Economics, English, etc.) and an additional Bachelor in Education are the minimum qualification. Therefore, our students include those who plan to only obtain the B. Ed. and teach at the primary level, as well as students who already have a first degree in their subject of choice but are looking to qualify as secondary teachers.

The minimum qualifications for enrolling in the Bachelor of Education Degree program at the University of Trinidad and Tobago are five Caribbean Secondary Education Certificate (CSEC) passes by the Caribbean Examination Council (CXC). The CXC is the examining body that provides educational certifications to the English Caribbean Countries and Territories and has replaced the British General Certificate of Education (GCE) examinations previously used. These standardized exams are usually given after the first five years of secondary school, at about age 16.

Rationale for Flipping

We have been teaching the Instructional Design course for nearly a decade. During this time, the course has changed greatly, the most recent change being a move from the second year to the first year of the B. Ed. curriculum. This was done to allow the students to have a firm grasp of proper learning design before they entered into their Practicum student teaching courses in the second year. The course includes in-class lectures and application of the material towards a high value group project out of class. From our experience teaching the course, we noted several issues arising, including:

- Difficulty in aligning schedules for group meetings
- Difficulty in working collaboratively on the project as some members were often not on the same page as others with regard to understanding the material
- Difficulty in applying the material presented in lecture format when they got home
- Poor class attendance (family issues were usually the cause)
- Difficulty in accessing (cost) and comprehending the text.

We thought that given the problems we saw, activities such as putting easy-to-understand material online and having the students do more of the group project in-class, with our personal assistance, might improve the learning experience for all students.

Model(s) and Theory(ies) Used to Guide the Flipping

The flipped design used in this course was guided by the ADDIE model. The modules of the course corresponded to the stages in ADDIE—Analysis, Design, Development, Implementation and Evaluation. Much of the discovery learning and scaffolding were infused in the course project through the use of the ADDIE Instructional Design Model, a design approach that encouraged students to analyze, synthesize and evaluate while building their analytical skills.

Structure and Implementation

Structure of the Flipped Course

The course was divided into work modules based on the steps of the ADDIE Instructional Design Model. Assessment of the learning was done through coursework and by an end-of-semester exam. The exam required the individual student to complete a mini instructional design under examination conditions, for 60 % of the grade. The coursework project required groups to create a full instructional design on a topic of their choice, for the other 40 % of the grade.

We worked on each module from ADDIE for two weeks. Students watched videos describing the ADDIE module they were about to work with. They also read a short summary of the material from the text, or a reading from the text. Each student was required to prepare one or two questions or statements from the readings or video to discuss in class.

The in-class time was devoted to group discussion of the concepts and working on the project in groups. By moving the bulk of the lecture content outside of class time, and the project group work to class time, we, as instructors were available, in person, to the learners for the following:

- Assistance in managing the collaborative group process
- Direct assistance in explaining concepts and the application of those concepts to their project

The groups were able to reduce scheduling conflicts by using class time. They also could assist each other with their projects. The "group and re-group" activity allowed the project groups to share their work with the whole class and benefit from the collective intelligence of the larger group. By the end of the semester, all of the groups had their projects completed, and there was no rush work required.

Preparation of Learners

In the first class session, the students were exposed to a short presentation on the flipped approach. The students considered their schedules, the way they preferred to work, along with other factors, and agreed to try the approach. This was done in

every class that we considered flipping. Over the three semesters, six classes chose to flip. We discussed with the students the tools that they preferred to use for collaboration and communication. They completed a hands-on session with the tools, setting up their groups and assisting each other with learning how to access and use the tools they selected. We also led a discussion of issues with motivation, understanding the material, time management and group dynamics.

Description of In Class and Out of Class Activities

Out of class activities were designed to introduce concepts and for students to learn the theoretical knowledge that they would apply in the in-class activities. Students accessed the learning content via the Learning Management System (LMS) and the video server. We used short videos to introduce the concepts and also to explain in a deeper manner certain key concepts emphasized. Narrated PowerPoint presentations were also used, with audio of the instructor explaining the material shown on the slides. Additionally, the course text was required reading, and each module included readings from the relevant section of the text. We also used Facebook groups for discussion of issues, topics, and responses to reflective questions.

In-class activities were divided into approximately three sections of about one hour each.

The first 30–45 min of in-class time were dedicated to discussion of the out-of-class material and concepts. The students presented their questions and comments, and these were discussed in a whole class setting. We also included reteaching of topics that were not grasped or about which there was confusion, in whole class, small groups and individual sessions when necessary. For example, if there were several students having difficulty with the same concept, a small group was created to work more on that concept. Discussion of group dynamics, scheduling and other practical concerns with getting the group project done was given approximately 15 min. This allowed us to introduce methods for coping with these issues as they occurred. We found that this just-in-time approach worked well.

The other two hour of class time were dedicated to a group-regroup activity. During group-regroup, students sat in their groups and worked on applying the concepts to their project, with the assistance of the instructors where necessary. These included research, discussion and creating their analysis, objectives, and strategies. At the end of about 60–90 min, each group presented to the whole class, allowing all classmates to engage in respectful critique of their work. Peer learning occurred via the whole class discussion of each group's work, so that other members of the class could assist, and each project benefitted from additional perspectives. Also, in discussing other projects, groups got ideas as to how to improve their own projects.

At the end of each two-week module, each group submitted the portion of the project required for that module. This enabled the instructor to assess how the students were applying the concepts to the project. Feedback was given, but no grades were assigned at this point. The submissions for each module were combined into the final project and grades were assigned at the end of the semester.

Tools Used to Support the Flipped Process and Learners

The course was supported by the Canvas and Blackboard Learning Management Systems (LMSes), and a MediaSite Video server. We used the LMS as a repository for handouts, textbook chapter summaries, links to videos and alternative readings. The MediaSite video server was used to upload and deliver the videos. We chose these because these were the tools available on our campus. We found that students did not often check their email. They preferred the immediacy of messaging, so we created a Facebook group for the class, so we could message and discuss with the class in a closer to real-time way, both outside and inside of class time.

For creation of the course resources, we used several applications, both free and paid. Tellagami (free) and PowToon (free) were used to make animated introductions and short videos, mainly to "set the scene" for the content that was to be covered in a module. PowerPoint (paid) was used along with Camtasia Studio (paid) and a webcam set up to make a video out of narrated PowerPoint slides with a "live" instructor discussing the slides. These tools allow for the insertion of quiz questions into video, which is a really good idea, but we could not make use of this feature at this time. We also needed to use MediaSite encoder (free) to properly prepare videos for uploading to the server.

Differentiation of Instruction

Students in the course were of different academic levels, from recent high school graduates to already degreed. Some students struggled with lower reading levels, so we created summaries of the relevant sections of the text. We needed to really keep an eye on where students were, and make sure that they didn't fall behind. The project groups submitted portions of their project every week and this allowed the instructor to determine where they were in terms of their application, and how well students understood new concepts. This first submission was used for discussion with the group in class time. They received feedback both from the instructor and from their peers. This brought them to a greater understanding of the concept on a weekly basis. We embraced peer learning in the classroom, and some of the richest learning experiences came when a group shared and received feedback from others in the classroom. The groups were also generally mixed ability groups, and the group members supported each other through the learning process, bringing their individual strengths to the table.

Assessment of Student Learning

The formal assessment of student learning for the course could not be different for the flipped and the non-flipped classes, as the flipped classes were only a few of the instructional design course sessions at the University, and we could not assign credit to flipped activities.

However, informal assessment was done. The LMS kept logs of student activity, and the video server likewise logged who accessed each video, whether they played it to the end or not, and how many times each student accessed each resource. So we were able to note who interacted with which online resource. Linking that information to the participation in class and the work that they submitted gave us information on how the students were progressing.

Lessons Learned

The Instructional Experience

Many students had trouble understanding the level of vocabulary in the textbook. The summaries that we wrote for difficult passages were very effective. We recognize that content creation is time consuming. When we, seeing a need, did the summaries of the chapters, we had to reduce the time spent on making the video for that session. We plan to prepare all our materials before the next session begins. One major problem was with maintaining student participation as the semester went on. Around midterms, several students stopped doing their out of class work. This led to an increase in the "reteaching" component of the class, as they had not prepared before class. We believe that this is due to the "back loading" of coursework assignments in the B. Ed. program. However, most students did continue with all the activities in the flipped class.

The overall process led to more participation in class, more collaboration among all the students in the class, and generally a more enjoyable course for all of us, both students and instructors. We will definitely repeat this, and attempt to implement it in more courses.

The Student Experience

Student feedback indicated that the YouTube and other non-local videos were difficult for them to understand. They particularly had issues with the fast paced American accent. They preferred videos in a local accent, with references that made sense to them culturally. We think that we need to consider this more carefully when choosing videos, and we will also create more videos ourselves.

The students expressed a preference for animation or webcam and PowerPoint videos combined over narrated PowerPoint with audio only. They indicated that looking at text slides with audio-only was boring and didn't engage them. They particularly enjoyed the animated introductions. Some also had difficulty with the language in the text. They did not have the required language skills to read at University level. The summaries of the text that we wrote were well received, and easily understood.

There was a noted improvement in in-class participation. The students were excited to come to class to work in their groups and to show the rest of the class

what they were doing. They were also excited to discuss the videos. There was also improvement in the work of students who missed class—they were better able to keep up with the coursework, including the group project, as they were able to access the materials online, prepare and connect with the project group by using the collaboration tools available.

A Case Study on Library Settings for Young People

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Instructional Context

Course Name and Description

Materials for Children is a course that considers critical evaluation and selection of materials for children in public libraries and school libraries.

Place of Course in Larger Program of Study

This online course is part of a graduate program in Library and Information Studies. It is an elective for the master's degree and one of two options for the required materials course for school librarian licensure.

Learning Goals of the Course

By the end of this course, students should be able to

- Read, review, and analyze a variety of literature for children
- Evaluate materials for children according to standard criteria, including language, aesthetics, style, and content
- Examine specialized sources for book selection and collection development
- Practice collection development methods to meet the language, learning, and cultural needs of diverse students and patrons
- Promote and recommend materials according to children's development, interests, and reading levels

Description of the Learners

The students are preparing for careers as professional librarians, most typically in school and public libraries. The full-time and part-time graduate students represent diverse academic and professional backgrounds. Many are currently working or volunteering in library settings.

Rationale for Flipping

With the popularity of online courses for adult learners in professional graduate programs, flipping is a viable option for *online* course meetings. Flipping honors students' time with efficient, productive learning and brings their critical thinking, dialogue, and application of content to the forefront. Flipping also models for my students how to flip instruction themselves, which they may do in classroom or library instruction, or in providing professional development to colleagues.

Models and Theories Used to Guide the Flipping

My instruction follows a constructivist approach, which includes such elements as unpacking content in ways relevant to students' needs and assessing process, not just product (Grennon Brooks & Brooks, 1993). I adapted the flipped instruction model from Bergmann and Sams (2014), making the adjustment to online synchronous meetings instead of face-time in a physical classroom. Resources on flipping academic library instruction were helpful, e.g., Datig and Ruswick (2013). A university faculty development cohort provided pedagogy and reflection on the affective experience of flipping with students who weren't necessarily accustomed to the demands of this model on their participation.

Structure & Implementation

Structure of the Flipped Course

In the week prior to each meeting, students view a "briefing" that combines original video and narrated slides. For my first iteration of flipping, I recorded an audio podcast, thinking portability of content might be helpful. I've since shifted to video to incorporate more visuals. The briefings are approximately 10–15 min in length, and include a preview of readings and content presentation. For this class, I also share a children's poem in each video introduction. For some modules, viewing additional external resources is required, such as read-alouds of picture books, storytelling performances, or webinars. During weekly online synchronous sessions, students draw upon the content that they viewed and prepared ahead of time in order to participate.

Preparation of Learners for Participating in Flipped Instruction

During the first class meeting, I facilitate a practice session of "mini flipping," in which students step away from the group to watch a video of me explaining a basic class concept such as required texts, with a question for discussion upon return—a glimpse of the model in which they'll watch a video and prepare for weekly meetings having ideas ready to share. We also check in regularly on the pace, clarity of instructions, and general comfort level with the structure.

Description of In-Class and Out-of-Class Activities

We typically begin class with a brief conversation on agenda, questions, and course schedule. Then for the bulk of the 90-min class, students participate in simulations, dialogues, literature circles, and other student-centered exercises. To design the activities, I consider content and logistics. The activities emphasize critical thinking, evaluation, or application. The exercises are relatively short in duration, with time allotted to debrief. Activities must be appropriate for an online setting, focusing on learning materials and collaborative spaces that are readily accessible.

The activities are sometimes individual, e.g., writing a brief reflection or thinking about a problem-solving scenario. Other activities are collaborative; for instance, students analyze and discuss illustrations from picture books or share dialogue about readings. In-class exercises also include construction paper modeling of how illustrations create meaning, comparison of professional publications for selecting books; and practicing read-aloud techniques.

Tools Used to Support the Flipped Process and Learners

My use of technology tools changes somewhat from term to term. I always use the university learning management system (currently Canvas) for posting modules, which serve as "home base" for each week's learning. Students access the readings and materials for class sessions in weekly folders.

I typically use VoiceThread to record webcam video and upload slides for the briefings. I offer lists of supporting resources using curation tools like Blendspace, Learnist, and YouTube playlists. At the start of the term, we use the online sticky note board Padlet for a community building activity, where students share something about themselves and also dip into the content for the term.

In class, we frequently use Google Docs for collaborative work processes. For example, for many small group discussions, students record responses or summaries on a shared class table in Docs. Students use the 90-s video response app FlipGrid to record and share video responses for promotional book talks and read-aloud practice.

Differentiation of Instruction

Interacting with flipped content before class affords flexibility for students in terms of time management and learning preferences. In the K-12 library setting, differentiation may include choices in both process (i.e., using different apps for consuming or creating content) and product (i.e., designing work products of varied formats, or for different audiences). I follow that approach in many assignments, whereby students make choices among resources and tools and develop products for authentic use in their library settings when possible.

Assessment of Student Learning

Assessment methods include student self-reflection, peer review, and instructor-provided rubrics with narrative comments. Google Forms and Docs are useful in collecting student contributions during class, such as group reports of literature circles. I encourage students to share works-in-progress and I provide formative feedback. I also ask directly for input on grouping strategies and dynamics of learning exercises.

Lessons Learned

The Instructional Experience

Flipping has been a natural step in my pedagogy, which was already largely a student-focused, constructivist style. Clarity is essential in communicating instructions and course schedule. So far, I haven't created many video briefings that I reuse from term to term. Briefings tend to integrate recent course discussions and current events, which I'm working to adapt to a more efficient model that presents a fresh introduction or conclusion with reusable content segments. Time to create and organize flipped content is a challenge, but one I'll accept in exchange for the leadership, critical thinking, and creativity shown by my students.

For future course implementations, I'm considering spreading out the synchronous sessions to every other week to allow more time and flexibility for reading deeply and developing projects. I also aim to incorporate into the videos more "look-for's" for students to "bring to class" to strengthen accountability. Another developing area is more video content from external sources, including student-made videos. I have flipped some, but not all, assignment instructions, and this is an ongoing goal.

The Student Experience

In course evaluations, many students indicate that they appreciate the flipped method, although some still prefer a more traditional lecture format, even online. By creating videos for the briefings ahead of time, students' voices become the focus of

the class, but this does place a sometimes-unexpected level of rigor on students. Preparation for class isn't a given; I can track the views on the briefings and they aren't consistently 100 %. Lack of buy-in can be detrimental to learning outcomes designed for a level of understanding entering into a task.

With these concerns in mind, I still stand behind the flipped philosophy. Flipping has provided a structured format for online learning experiences that provides much of the interactivity that face-to-face classes afford. As this student shared in a course evaluation, flipping fosters student engagement:

> [Flipped instruction] really keeps [students] accountable for class readings. It also encourages more class participation and discussion of topics as opposed to just sitting and listening to the professor teach the material for 2-3 hours. … [students] are able to read materials and watch videos before hand and then come to class prepared with questions and comments. I can't say enough great things about the method Dr. Morris used to teach this class.

A Case Study on Reading Methods

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Instructional Context

Course Name and Description

The *Literacy and Racial Awareness* course was a co-taught reading methods course that combined two previously independent courses: *Critical Literacies in Secondary Schools* and *Content Literacy for Special Educators*. The courses were combined to provide opportunities for collaboration among general and special educators and to demonstrate co-teaching strategies. Requirements included a weekly face-to-face meeting along with a 45-hours semester-length clinical experience in an urban school.

Place of Course in Larger Program of Study

The course serves as a requirement for students for upper-year credits in reading and writing for secondary English majors and for special education majors in fulfilling a requirement for the state's 12-hours reading mandate.

Learning Goals of the Course

A central goal for the course was to establish a firm understanding of the integral role one's racial awareness and bias plays in the teaching and learning of literacy skills. While fulfilling a program literacy requirement, students were to demonstrate understanding of the reading process of constructing meaning through the interaction of existing cultural knowledge, also noting how content, purpose, tasks, and setting, influence engagement.

Description of the Learners

Fifty preservice students were completing a four-year, initial licensure program in secondary English language arts and special education. The majority of the students were in their early twenties, 92 % of whom were white. English education students were sophomores and special education students were juniors.

Rationale for Flipping

The flipped model was an approach that enabled students to more meaningfully engage with challenging content through practical application of reading and writing strategies in an urban school. By contrast, sitting through time consuming lectures on scholarly readings related to race and literacy would have left listeners passive. Most importantly, because readings about race evoked strong cognitive and emotional responses, students needed processing-time to construct personal stances. By flipping the classroom, students had consistent opportunities to interact with readings and generate integrated responses, balancing emotional reactions with further reasoning. Finally, the instructors benefitted from reading responses 24 hours before class, allowing student perspectives to guide instructional choices.

Models and Theories Used to Guide the Flipping

Our flipped classroom adopted a learner-centered approach that paid specific attention to the prior knowledge, skills, attitudes, and beliefs that students brought into the educational environment. The approach included teaching practices that were culturally responsive as well as diagnostic. During the face-to-face (f2f) interactions, participants defended and/or modified individual beliefs. By applying new knowledge in the clinical setting, a greater complexity of understanding was promoted. Practice with new or confusing concepts allowed for increased risk taking, conceptual change, and development of further expertise.

Structure and Implementation

Structure of the Flipped Course

A variety of formats supported the learning environment. Readings that elicited cognitive dissonance required a flexible writing-response process, designed to guide readers through difficult text. The use of structured comprehension responses encouraged active reading that recalled background knowledge and noted questions or reactions when they occurred. In addition to discussion formats, in-class work included Agree/Disagree, and other pre- and post-reading activities that required students to take a position on a topic.

Preparation of Learners for Participating in Flipped Instruction

Because course content was designed for intentional engagement of cognitive conflict before f2f class time, the flipped model allowed students to develop and evaluate their own perceptions, explaining reasons for their positions before coming to class. With this in mind, instructors prepared students for the flipped reading by demonstrating strategies for self-regulated learning habits, such as self-monitoring of emotional and cognitive responses to the readings. The flipped reading process gave students an opportunity to think through personal positions, while at the same time, welcoming a variety of responses. There were opportunities for guided practice and immediate feedback through the use of explicit instruction that utilized clear descriptions and modeling. In this way, instructors provided context for the assignment.

Description of In-Class and Out-of-Class Activities

For out-of-class activities, students completed five major assignments during the semester. These included: flipped reading blogs, racial awareness autobiography, case study, and a literacy playbook. On the flipped reading blog, students posted responses to eight scholarly readings on race. In the case study, students compared their cultural background, educational experiences, and racial awareness journey to a pupil within their clinical field experience with whom they had developed a relationship. The literacy playbook was designed for practical use; each literacy playbook contained 10 self-selected reading strategies that addressed an array of literacy needs related to comprehension, vocabulary, fluency, and responding to literature. The playbook served to contextualize the clinical experience and included learning targets for individual learners, connections to Common Core State Standards, and attention to academic language as well as pupil strengths and needs.

For in-class activities students engaged in weekly discussions and activities. Discussions included reflection upon examples of personal and systemic racism, a break-through experience, and their hopes for equitable teaching. The group discus-

sions/activities related to race and counter storytelling while other discussion formats included small group presentations of literacy strategies. Presentations used a tell-show-practice approach, allowing students to collaborate and implement the strategies with varying peers.

Tools Used to Support the Flipped Process and Learners

With a weekly electronic blog, posted 24 hours before class, students discussed new or modified thinking. Within such groups, course professors would anonymously select quotations from students' blogs and read them within assemblies of 10–15 students, prompting further discussion.

Differentiation of Instruction

An important goal of instruction was to develop and deepen student understanding with the application of knowledge in authentic contexts. Having a paired clinical experience with utilization of the flipped classroom provided consistent opportunities to apply literacy strategies and focus on student understanding. By using the flipped structure, valuable class time was used to work with our students to identify and design subsequent experiences in the clinical setting. The flipped structure created more opportunities and space to highlight the unique experiences of the pupils our students were working with and how to incorporate pupil background knowledge and experience into meaningful lesson planning and design.

Assessment of Student Learning

In previous iterations of the course, students presented lowered expectations for individuals of color. Formerly, racial bias was generally unexamined and we found ourselves unaware of the multiple realities of other racial groups' experiences. A subsequent needs assessment led to a course restructuring process where faculty and students explored literacy and racial awareness through examination of racial bias using the flipped method.

Flipped responses, as well as other assignments, served as data to assess progress and engagement. Discussions about their interactions with a specific learner within their clinical field placement empowered students to analyze personal upbringing, educational experiences, as well as other cultural and personal similarities and differences. While building deeper connections about educating individuals of color, participants evaluated prior beliefs and assumptions for further development as prospective educators.

Lessons Learned

The Instructional Experience

An imperative for our teacher education program is to prepare preservice teachers to develop a learning process that not only addresses the curriculum, but at the same time, empowers diverse students. The flipped classroom structure provided an effective approach to deep growth of knowledge, the defense or modification of beliefs, and the application of skills within a clinical experience by giving students extended time to consider their own beliefs and dispositions and then, in discussion, consider multiple perspectives. Education students were exposed to diverse perspectives and were challenged to question previously held beliefs. For some participants, the learning process was life changing, for others, learning deepened conceptual understanding. In all cases, due to flipped learning adapting the role of the instructor, from lecturer to mentor and co-leader, the flipped learning environment was dynamic and served as a model for future practice.

The Student Experience

Comments such as the following were not unusual, "I really liked how we modeled different strategies and worked in groups. All of the readings (flipped blogs, textbooks) were very useful and I learned a lot." One student, a 20-year-old, white, female stated the following: "Before entering this flipped classroom, I had few diverse and culturally broad experiences. As a result of this course, I was able to connect my ideas and memories to new realizations gained through readings, assignments, and discussions, further developing my understandings in an urban school context. By reflecting on my experiences and racial awareness, learning concepts such as white-privilege, color blindness, and meritocracy, I observed others through a lens that differed from my own. While the process was at times difficult and emotional, I became increasingly conscious of all that I must learn and involve myself in order to strive for expansive racial awareness as a new teacher. As my vision of race broadened and adapted to knowledge gained, I became a stronger educator. This new learning will transcend my teaching abilities, allowing my students to reach similar realizations in their own lives. Further, this will develop our potential to become positive and contributing members of society."

A Case Study on Science Methods

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Instructional Context

Course Name and Description

Science for the Child is a three-credit elementary science methods course requiring 45 contact hours per semester and scheduled once per week for three hours. Three meetings were suspended to allow students to conduct individual or group activities in the community. The course uses the 5E's instructional model (Bybee et al., 2006), engage, explore, explain, extend, evaluate. This sequence leads learners through a systematic inquiry process to experience the culture of science as a base from which to construct a personal vision of elementary school science consistent with current state and national goals.

Place of Course in Larger Program

This course is part of the preservice elementary teacher preparation program. Students are required to enroll in one methods course for each of the disciplines they will teach. This science methods course was the only flipped course. This section was comprised of a cohort that was together for two years in a new program sequenced by faculty and in which diversity and inquiry were strands explicitly emphasized.

Learning Goals of the Course

Students are expected to (a) develop a foundation upon which to continue to construct their understandings of decision making for curriculum, instruction, and evaluation, (b) construct an image of themselves as active participants in scientific inquiry, (c) eliminate negative stereotypes of scientists and alleviate alienation from science, (d) develop self-efficacy, learn to use computer technologies, and become autonomous learners, and (e) develop a path to continue self-directed development as an effective science teacher.

Description of the Learners

There were 33 students. Three were males. Ages ranged from 18 to 50+ years. Twenty-seven were between 18 and 24, three were between 25 and 32, two were between 33 and 40, and one over 50. Students were enrolled in 18 credit hours per semester. The majority of students characterized themselves as unsuccessful in school science, feared teaching science, and did not see its relevance to their lives which influenced the decision to flip the classroom.

Rationale for Flipping

We flipped the classroom because this context facilitates students moving from passive to active learners while conducting open-ended systematic inquiry (do science) as explicated in the Next Generation Science Standards (NGSS) (2013).

Model(s) and Theory (ies) Used to Guide the Flipping

Theory informing course design was pulled from research in constructivism, inquiry learning, and communities of practice. Constructivist learning theory (Vygotsky, 1986) places the student at the center of meaning making by using prior knowledge to connect to new data. As a student-centered approach, constructivist theory also supports inquiry learning (doing science) since the scientific enterprise builds on prior knowledge to construct more sophisticated understandings of natural phenomena guided by questions emerging from prior knowledge and observation. This learning occurs in a community as scientists ask for review and insights from colleagues.

The flipped classroom supports theory from these fields in that learning takes place as students: (1) gather information from different sources (experiences), (2) identify that which is relevant to the question and label it data, (3) organize data to search for patterns, and (4) construct interpretations of meaning from relationships. Relating what is learned to the community is an integral part of the process, and requires deliberate strategies for feedback and support. The flipped classroom approach emerged as a viable solution for incorporating constructivist learning in a science classroom. The introduction of personal computers provided another avenue for student choice through a virtual resource center (VRC) and additional media options.

Structure and Implementation

Structure of the Flipped Course

The course was structured as an inquiry, "What characterizes science teaching in elementary schools consistent with *Next Generation Science Standards* (NGSS)?" Students gathered data to answer this focus question from five complimentary

strands: (a) textbook (at home), (b) small and large group in-class experiences, (c) materials in the virtual resource center, (d) learning tasks outside of class, and (e) electronic discussion board.

The instructor orchestrated learning opportunities that empowered students to construct meaning from course experiences. The student's role was to be empowered to collect data and actively make meaning from course experiences. Each student assumed the responsibility of being an active participant of the learning community.

Preparation of Learners for Participating in Flipped Instruction

The instructor explained the flipped classroom in the syllabus and discussed the idea during the first class. Students' prior knowledge and beliefs about learning in a traditional classroom compared to learning in a flipped classroom were then ascertained by answering these questions: What is teaching? What is learning? Who is responsible for learning? What is the role of the teacher? What is the role of the student? What is the function of assignments? Students then discussed answers in small groups and shared with the entire class.

Description of In-Class and Out-of-Class Activities

Classroom time was primarily for group interactions/discussions and students' product presentations illustrating knowledge constructed. Assignments done outside the classroom were treated as drafts to be refined by input from classmates and the instructor then finalized. Product development directions were open-ended with minimal guidelines beyond the purpose of the product, thereby encouraging learners to express creativity when they presented sense made from an inquiry. Examples of out of class activities include: interviewing a scientist, exploring a place in the community, and a service learning project. For a complete list and description see Table 2.

Tools Used to Support the Flipped Process and Learners

The primary tool supporting the flipped process was a virtual resource center (VRC) in a computer assisted learning management system (CANVAS). The VRC contained various resources including print and media (peer reviewed journal articles, videos, etc.). Resources were organized in bins in the VRC, each supporting a specific topic or objective to be completed by the end of the course. Throughout the semester, resources for a specific topic were identified by the instructor and students were directed to select items for study. Further, they were encouraged to add relevant items encountered in their daily lives to the VRC. CANVAS also contained areas in which students posted assignments, received feedback, journaled with peers, and contacted the instructor.

Table 2 Learning opportunities

Learning opportunity	Description	Purpose	Points (200 total)
ONE TIME			
Biography	Demographic Information Science Experiences	Facilitate Communication Establish a baseline of science knowledge and attitudes	5
Internet Visit	Select an Internet hands-on minds-on activity-bring materials to class to do it with a group	Analyze activity for characteristics of elementary science teaching consistent with NSES	15
Site Exploration	With a group, explore a place in the community and tell how you would use this site with children	Make learning science and technology relevant Learn to use community resources	20
Interview	Select someone you consider to be a scientist Interview him/her using your own open ended questions	Make learning science and technology relevant Provide access to community resources Create awareness of science careers	15
Service Learning Project	Work in groups following the Earth Force format in the VRC	Contribute to resolving local real world issues while applying science	15
Final Project	Design a science unit plan (minimum five days) for your future students using your site visit and, or, service learning project as cameos.	Understand how to design and carry out student-centered inquiry based learning opportunities	20
MULTIPLE TIMES			
Weekly Journals	Indicate the data you are collecting and analyzing about science and teaching and learning throughout the course	Learn more about yourself Learn how to put thoughts into words Learn how to communicate—give and receive feedback Avenue for professional growth	35 (total for all journals)
Self Assessment (Twice)	Complete a multi question assessment	Help you think about what you are learning Provide evidence of your learning	Course is incomplete without this assignment
Professional Disposition	Interactions in and out of class	Develop professional attitudes and dispositions	35

Learning opportunity	Description	Purpose	Points (200 total)
EXAMS			
Quizzes	Unannounced 10 min tests, each with a different style question	Stimulate students to study text and VRC Provide discussion of various test taking strategies	20 (total)
Mid Term	Students contribute questions from which instructor builds the exam	Learn how to construct test questions that accomplish your goals	10
Final	Students contribute questions from which instructor builds the exam	Give students ownership Enable students to vote to eliminate the test and add points to projects	10

Differentiation of Instruction

The structure allowed learners to choose among resources to study for a particular topic as it was introduced. As learners gained more knowledge they were able to make connections between topics and use resources throughout the VRC to meet the criteria for their learning opportunities (assignments). Each student controlled the amount of time he/she used to construct understanding, because the student gathered information at his/her own convenience for location and time. Students received support through peers and instructor both face-to-face and electronically.

Assessment of Student Learning

Learning and evidence of a paradigm shift was assessed through methods ranging from mechanistic to holistic. Evidence was gathered from student provided data in self-evaluation. The self-evaluation listed all the criteria the instructor used to evaluate learner performance in the following categories: understanding of aligning teaching with the NGSS, professional dispositions, extent of paradigm shift, and class participation. Then a letter grade was given with an explanation of where the instructor agreed or disagreed with the student's self-assessment/self-evaluation. Assessment was similar to previous iterations of the course.

Lessons Learned

The Instructional Experience

This class is the first in which all students experienced a paradigm shift toward both the flipped classroom and the academic content. Students engaged in the flipped classroom recognized the effectiveness of a student-centered approach and became confident they could teach science. Two factors not previously reported supported the paradigm shift. The department chair backed decisions the instructor made when students complained about course design and assignments. The program sequence was designed by faculty and included inquiry as a thread. Consequently the instructor's approach was also reinforced by other faculty.

The Student Experience

Similar to previous course iterations, students moved from totally dependent learners to varying degrees of autonomous learning, and increased self-efficacy, visible in positive attitudes towards science and belief they can further learn science and teach science. The reader should be aware that students will initially resist the flipped approach because of a fear of failure of working in an unfamiliar structure. However, in our experience, those most initially resistant became the biggest advocates for science teaching.

A Case Study on Technology Integration

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Instructional Context

Course Name and Description

The course for this case, *Technology in Education*, is a two-credit course required of most undergraduate teacher education majors. It focuses on technology integration for teaching and learning.

Place of Course in Larger Program of Study

Prior to this course, or specialized equivalents for some subject areas (e.g., art, music, and mathematics), students complete or test out of a one-credit technology skills course. At the time of flipping this course it was an upper division course, meaning that students would take it either as juniors or seniors. It has since been removed from upper division, resulting in students taking the course earlier in their programs.

Learning Goals of the Course

The learning goals of the course are for students to understand how to integrate technology into their future teaching, including the thought process behind their selections of different technologies and the reasoning behind their specific selection versus alternatives.

Description of the Learners

The majority of learners are traditional 18–22 year old students, with students skewing younger now that the course is no longer limited to only upper division students. The course also contains some older students who have changed majors, are non-traditional students, or have had other careers. The non-traditional and other career students that take this course are attending college for the first time and are working towards their first bachelor's degree or in rare instances, an additional bachelor's degree, instead of licensure only options to add to an existing degree.

Rationale for Flipping

Flipping the course was not initially planned during the semester that this occurred. Since I was already producing numerous videos and podcasts for online versions of the course, this became a partial flip experiment. The sharing of the resources with face-to-face classes started as a form of additional scaffolding, but it became clear that the course was gradually becoming more and more flipped. This continued because it was allowing face-to-face time to be better utilized than previously was possible.

Models and Theories Used to Guide the Flipping

At the most basic level the Analysis-Design-Development-Implementation-Evaluation (ADDIE) framework was applied in cycles with instructional videos produced at the start of each unit and summary podcasts at the end. This constant cycle of design and evaluation helped me to introduce and scaffold students through each technology resource option. With a strong foundation being developed outside of class, better prepared students became a great resource to each other, allowing less dependence on me for basic questions and more time for discussion, problem solving, and reflection in class.

Structure and Implementation

Structure of the Flipped Course

The course followed a regular pattern of asking questions: What do we know? What are we learning? Where are we going next? Each week focused around a specific task (e.g., an informative multimedia presentation, a classroom website). Different technology options for accomplishing that task were introduced, discussed, and students could then choose how they would address the task. Students progressively developed more of the basic skills due to resource exposure outside of the class meetings, allowing more in-class time for discussion, application, and reflection. The course built up to two larger projects, a complete technology integrated lesson plan and an ePortfolio. These culminating activities allowed students to fully design a lesson and explain the rationale behind their technology integration decisions as well as reflect on everything they had learned during the semester, their overall growth, and what technology resources they were going to continue to use in the future once the course had ended.

Preparation of Learners for Participating in Flipped Instruction

I had not decided to flip this course at the start of the semester, so I hadn't discussed it with my students or tried to shape any initial expectations ahead of time. In-class and out-of-class activities were initially the traditional approach of learning what to

do in-class and working on it out-of-class. I first mentioned that resources that covered the same things which would be covered in class were available online. Gradually, in-class demonstrations of tools became faster and less detailed, focusing more on traditional problem areas and points that had been generating questions over e-mail. Eventually I emailed students indicating that new materials were available online and should be viewed prior to class so students would have a better understanding or be able to work ahead. The shift led to learning about the tools outside of class and using in-class time to discuss how, when, and why the use of certain technologies might make more sense.

Tools Used to Support the Flipped Process and Learners

While still regularly using the student management software and e-mail, I relied heavily on both screen capture and podcasting software. Licensed software was used while on campus and free alternatives were used when working away from campus. This helped me provide free alternatives that could be shared with students so that they could create their own materials for their future teaching. The use of screen capture allowed me to guide my students through different resources with the same detail as I would have normally in class. The use of podcasting software allowed me to provide rich feedback to students that could be both humorous and entertaining instead of through large blocks of texts. No other tools were used during this partial flip experiment.

Differentiation of Instruction

The tools and partial flip allowed greater freedom towards differentiated instruction because students who didn't need as much support could freely work ahead. Those students who needed additional time and support could view materials as much as necessary and look ahead to see if there were upcoming assignments that would require additional time or assistance. Based on student questions over e-mail, during office hours, or after class time I could also produce additional materials as well as pick up on trends I was observing in the questions being asked.

Assessment of Student Learning

I looked for changes in level of engagement, quality of class discussion, types of questions being asked, and what revisions could further aid students. With the partial flip I noted having more time for class discussion and interactive activities and having to dedicate less time used for basic skill instruction. Demonstrations could instead focus on specific questions and examples instead of generalities. Students were also more likely to have worked ahead and be willing to help classmates because they knew more about the assignments as opposed to past students who helped because they had past experiences with certain tools.

Lessons Learned

The Instructional Experience

The main lesson learned was that even with an abundance of resources provided; some students would not utilize them. Since this class started out in a traditional format and was gradually flipped, it is likely that some students were resistant to the change. Had the intent of the flip been made more overt, or outright announced early in the course, it is more likely that utilizing the resources would have been embedded as part of all students' understanding of course expectations including the need to develop better self-regulated learning practices.

Another lesson learned involved my use of some free tools for developing tutorials. While it was intended that students might use these resources in their professional teaching, some students utilized them for seeking help. Instead of just asking for help over e-mail, some would create videos or podcasts walking me through their questions and thought processes. This allowed me to provide them with specific responses and support instead of having to do general troubleshooting over e-mail until eventually understanding what they were really asking. Modeling such a process as a course expectation could lead to a much more satisfying support process for me and my students as both the problem and solutions might be made clearer, quicker.

The Student Experience

Some students appreciated having materials available online and having the option to work ahead. Many students who worked at the regular pace of the course utilized the materials to be able to review concepts or do their own troubleshooting if they couldn't get something to work. Students who utilized the resources were also able to provide just in time assistance to classmates who might be struggling with in-class demonstrations or working through projects during class time. Those students who helped would also sometimes develop different perspectives on the projects as they talked with classmates, noting areas that might be meaningfully connected to projects from other classes or aspects of the project that might provide challenges to their future K-12 students and need revision.

References

Bergmann, J., & Sams, A. (2014). *Flipped learning: Gateway to student engagement*. Eugene, OR: ISTE.

Bybee, W. R., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., & Landes, N. (2006). *The BSCS 5E instructional model: Origins, effectiveness, and applications.* Colorado Springs, CO: BSCS.

Caine, R., & Caine, G. (2006). The way we learn. *Educational Leadership, 64*(1), 50–54.

Datig, I., & Ruswick, C. (2013). Four quick flips: Activities for the information literacy classroom. *College & Research Libraries News, 74*(5), 249–257.

Grennon Brooks, J., & Brooks, M. G. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria, VA: ASCD.

Gulpinar, M. (2005). The principles of brain-based learning and constructivist models in education. *Educational Sciences: Theory & Practice, 5*(2), 299–306.

Jensen, E. (1998). *Teaching with the brain in mind*. Alexandria, VA: ASCD.

Johnson, D., Johnson, R., & Holubec, E. (2008). *Cooperation in the classroom* (8th ed.). Edina, MN: Interaction Book Company.

Mayer, R. E. (2005). Principles for managing essential processing in multimedia learning: Segmenting, pre-training, and modality principles. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 169–182). New York, NY: Cambridge University Press.

McVay-Lynch, M. (2001). Effective student preparation for online learning. *The Technology Source*.

NGSS Lead States. (2013). *Next generation science standards: For states, by states*. Washington, DC: The National Academies Press.

Tomlinson, C. (2004). *The differentiated classroom: Responding to the needs of all learners*. Alexandria, VA: ASCD.

Vygotsky, L. S. (1986) [1934]. *Thought and language*. Cambridge MA: MIT Press. ISBN 978-0-262-72010-6

Flipping Engineering

Abstract This chapter contains case studies from Engineering. Case study authors discuss Vygotsky's influence on their choice to use audio, visual, and print materials to scaffold instruction. Concepts from ADDIE and the Successive Approximation Model are also used to guide the development of content and selection of materials. The case studies emphasize the structuring of learning experiences based on individual competencies. Each case study opens with the instructional context and a rationale for flipping the classroom. The case study authors also describe the structure of the course, as well as descriptions about how they prepared their students for flipping, and an evaluation of the flipping experience from both the instructor and student perspectives.

A Case Study on Chemical Engineering

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Instructional Context

Course Name and Description

During this course, teams of five or six students undertake engineering projects proposed by practicing professional engineers who act as industry advisors. Each team must integrate chemical engineering practice, theory, and economics into a validated and sustainable design of a complex open-ended capital project. Four co-instructors teach the course. Each instructor meets weekly with six to eight teams to mentor, monitor, and evaluate their progress.

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Educational Communications and Technology: Issues and Innovations,
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Place of Course in Larger Program of Study

Students take this course during the final term of their undergraduate program, following completion of fundamental knowledge based courses and an introductory design course.

Learning Goals of the Course

The primary goal is to have students design and develop solutions for complex open-ended engineering problems. These are authentic projects proposed by industry partners. Successful completion requires students to synthesize and apply the core concepts and skills they have developed throughout their undergraduate program.

Description of the Learners

Entrance into the degree program requires an 85 % average from high school. Approximately half of the students follow a regular four-year undergraduate program (~30 % international students) and half follow a five-year cooperative education program including 20 months of industrial experience. In addition to developing knowledge and skills in core chemical engineering subjects, some students have developed specialized knowledge in computer process control, biomedical, or oil sands engineering.

Rationale for Flipping

The flipped approach was catalyzed by a desire to more effectively address student learning depth and heterogeneity, engagement, and to enhance student and instructor interaction quality. Flipping increases in class time available for students/teams to interact with instructors formally and informally, and provides a strategy for accommodating expected enrolment increases while improving learning quality.

Models and Theories Used to Guide the Flipping

The experiential learning and team approach used in this course embodies social constructivist and collaborative learning theory (Laurillard, 2012; Vygotsky, 1978). Teams provide safe and constructive environments for articulation and evaluation of ideas, and for achieving consensus. Theories from Csikszentimihalyi (1990) and Vygotsky (1978) guided many pedagogical decisions related to online content. Resources, advanced/remedial supplemental materials in audio, visual, and print formats were used to scaffold instruction to facilitate learning. Concepts found in the ADDIE instructional design process, and the iterative successive approximation

model (Allen & Sites, 2012) were used for content development and for selecting materials to be delivered online or as in-class activities. Rapid prototypes were prepared, critiqued, and modified prior to delivery. Students contributed to the evaluation of materials post delivery. Their evaluations are informing revisions for the second iteration of the course.

Structure and Implementation

Structure of the Flipped Course

Moving instruction online opened up time for in-class application of concepts, for teams to meet and work together, and for questions/discussions with all instructors. Students attend two four hours sessions per week. Each session includes pre-class online elements such as short videos starting with familiar content then developing concepts further. Online content is applied during class using active learning formative assignments related to design projects. Group discussions, project work and formal team/instructor meetings followed. Post-class online elements developed concept application and extension to individual design projects. A desire not to exceed previous course time commitments for students required vigilance.

Preparation of Learners for Participating in Flipped Instruction

Advice on how to succeed in a flipped classroom was provided. The roles and importance of pre-class learning, participation in in-class activities, submission of active learning assignments were emphasized, and key assignment details were provided.

Description of In-Class and Out-of-Class Activities

In the design of this course, attention was paid to the integration of online and in-class components to demonstrate their connection to students. Online materials were organized under four major headings: Pre-Tutorial, Tutorial, Post-Tutorial, and Resources. Pre-Tutorial materials provided instructional elements and content background required for the in-class portion of the course. Agendas and worksheets for class activities and post-tutorial online materials addressing stretch goals were also provided in the learning management system (LMS).

The Heat Exchanger Network Design session exemplifies the approach taken. For pre-class work, students watched three, five-min videos that contained materials covered previously in lectures. The first two videos covered energy integration concepts and calculation method description. An example application solving “Above the Pinch”, described in the third video, connected with the in-class activity. The in-class time used active learning, which allowed students to solve a more complex version of the online design example. Learners recorded solutions using a prepared

worksheet and posted solutions to the LMS by the end of class. Teams worked together to solve the "Below the Pinch" case while instructors facilitated learning as required. The balance of the class time was used for team meetings with instructors, independent student/team learning, and application of tutorial learning to their own projects. Post-class work required the students to apply these concepts to determine the energy integration potential for their projects and to report results in their final reports. A fourth video describing energy integration incorporation into process simulation software was provided for enrichment.

Tools Used to Support the Flipped Process

Online materials were developed using PowerPoint for storyboarding, sequencing, and animation, Garage Band for recording, Camtasia for assembly and post-production editing. Images were sourced from Shutterstock and instructor materials. Forums, assignments, resources, and links were presented and organized using the LMS.

Differentiation of Instruction

Differentiation of instruction was multifaceted. Online instructional materials provided students with flexibility in controlling the pace of content delivery while in-class activities provided students with just in time teaching. Additional resources were added to the LMS and students were directed to resources specific to their needs. The students also facilitated differentiation of instruction as they provided peer support in the collaborative team structure. Instructors and industry advisors provided feedback.

Assessment of Student Learning

Assessment was based on milestone assignments (20 %) intended to progress students through their design project, a portfolio (five percent) intended to encourage completion of in-class active learning assignments, and a final report (75 %).

Lessons Learned

The Instructional Experience

We found short, focused, and well-scripted videos reduced time spent delivering content. Content typically taught during a 50-min lecture was covered in videos with a total duration of 15 min or less. We learned that written materials must accompany online videos in order to accommodate student study and review

preferences. During the pilot, we did not always have written materials prepared and students missed them when they were absent. Carefully crafted videos and related in-class activities take significantly more time to prepare than conventional lecture materials. With these now in place, future preparation time will be reduced. In-class activities require innovative thinking, iteration, and adaptability to match the activity to the learning requirements and skills of students. When the right mix is achieved, the learning and the energy in the classroom is uplifting.

At times tasks were beyond some students' skill levels. These activities will require additional guided analysis/scaffolding and refinement prior to reuse. In-class interactions were enhanced and were valuable to learning. They also strengthened relationships among students and between students and instructors. The relationship between the online content, the related in-class activity and team projects must be explicit. It was worthwhile to review these connections at the beginning of each class.

Automated on-line data gathering tools found in the LMS provide valuable information to guide instructional decisions and to inform continual improvement, research, and accreditation audits. Examples include: the frequency and timing of materials use, student skill self-assessments, team self-evaluations, and formative assignment evaluation. These tools also facilitate rapid feedback to students/teams on their progress and their needs.

The Student Experience

Students provided feedback throughout the course and participated in an online survey at the end of the course. Their reactions to the blended format were mixed. This was related to the transitional organization of content on the LMS as the course was redeveloped. The volume of resources available and increased online instruction and direction made it difficult for some students to find what they needed when they needed it. Students were often prepared for tutorials and at times had already applied their learning to their projects ahead of class. Although the final marks and team performance were comparable to previous cohorts, individual experiences were varied. Student perception of their role and the instructors' roles may account for some variability of experience. The course redevelopment further shifted the responsibility and accountability for learning from the instructors to the students and some students resisted this shift.

A Case Study on Chemical Engineering II

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Instructional Context

Course Name and Description

Material and Energy Balances introduces the application of material (mass) and energy balances for analysis of equipment and processes in the chemical process industries.

Place of Course in Larger Program of Study

This is a gateway course in the chemical engineering curriculum taken in the second year of study. Application of these balances is a defining characteristic of the chemical engineering profession.

Learning Goals of the Course

The primary learning goals are to organize complex information about chemical processes, use that information to derive material and energy balances, and apply these balances to analyze chemical process systems.

Description of the Learners

Students taking this course are either sophomores or transfer students. Course prerequisites include two semesters of general chemistry and calculus, and an engineering problem-solving course.

Rationale for Flipping

There were two reasons for flipping the course: student engagement and improving teamwork. I observed Dr. Brewer teaching another course with Team Based Learning (TBL) and was struck by the high-level of student engagement and the depth of discussion within the student groups. In previous offerings, homework teams were left to organize themselves on their own time. Most teams divided the homework and each student worked their problems independently. The teams often "met" just before class on the due date to assemble their contributions. Switching to TBL brought the teamwork into the classroom and ensured that all students collaborated regularly.

Models and Theories Used to Guide the Flipping

There were two reasons for flipping the course: student engagement and improving the effectiveness of Team Based Learning (TBL). TBL is an instructional strategy

with structures and incentives that promote high-performance learning teams (Michaelsen, Knight, & Fink, 2004; Sibley, Ostafichuk, Roberson, Franchini, & Kubitz, 2014). Individual students complete assigned readings and practice problems outside of class. During class, they complete quizzes and application exercises as teams (five to seven students). Processes for readiness assurance and peer evaluation create individual accountability.

Structure and Implementation

Structure of the Flipped Course

The students meet for one hour three times per week. They spend one to two hours preparing individually for each class session by completing a reading guide written by me and posted on the learning management system.

The course is divided into seven modules. Each module contains a readiness assurance quiz on day one of the module, followed by three to nine days of application exercises. Exams are given at the end of Modules two, four, and five.

Preparation of Learners for Participating in Flipped Instruction

Learners receive a welcome email before the first day of class that introduces the course goals and explains that students are expected to read and study outside of class. I encourage students to schedule this study time before the semester starts.

The course begins with a two-day orientation module to model the TBL processes. Day one is forming teams and having teams complete their first application exercise. On day two, students take a quiz over the course syllabus. After each activity, I answer questions about the procedures and what these will look like once we start using course content.

Description of In-Class and Out-of-Class Activities

The reading guide contains the learning objectives for the upcoming class meeting, an itemized reading list (about ten pages of the textbook, including worked example problems), concept questions, and tips for reading tables and graphs, and one homework problem. The problem is selected as a routine problem that students can solve independently by following a worked example from the reading. The problem is collected and graded.

At the start of each module, individual preparation and team performance are assessed through a multiple-choice quiz, given in class, that is designed to test concepts from the reading. Individuals take the quiz, submit their answers (without feedback), and then retake the quiz with their team. The teams get immediate feedback and must keep trying until they answer the questions correctly.

For the remainder of the in-class sessions in a module, the teams complete application exercises that require students to apply course concepts to analyze and solve problems. The application exercises are designed to follow the "Four S" principle: significant problem, same problem, specific choice, and simultaneous report. The students are given a chemical process description that ends with a question. The teams are never asked to perform the calculations needed to answer the question because that requires much writing (which is best completed as an individual activity). Instead, teams focus on making decisions about the problem-solving process: "Is the ideal gas law assumption appropriate here?" "What is the best reference state for each chemical species in the reactor?" Teams' conceptual understanding is assessed by tasks like: "Sketch a plot of …" or "List four reasons why …" During class, I give mini-lectures when asked to address difficult concepts or when I observe widespread misconceptions.

Tools Used to Support the Flipped Process and Learners

To support the flipped class, I use a variety of in-class strategies: team folders, moveable tables and chairs, a document camera and projector, and student-response systems ("clickers"). The folders are used to distribute and collect materials (quizzes, activities, notecards, team clickers) and are submitted at the end of the class. Providing one paper copy of the application exercise works best, in addition to projecting the activity on screens in the classroom. Teams arrange the furniture such that all team members can see, hear, and contribute. Students often push two tables together to create a large work surface for sketching, brainstorming, and consulting their books. Mini-lectures and occasional team "show-and-tell" sessions make use of the document camera and projector. Each team has use of one clicker, which is used to collect and record team responses simultaneously during application exercises. Other methods, such as providing a set of colored cards to each team, can also work. We use the learning management system to electronically distribute the reading guides (about a week in advance), solutions to homework (after class), copies of in-class activities (after class), and peer evaluation surveys.

Differentiation of Instruction

During team application exercises, we observe teams and listen to the discussions. When a team requests help we provide coaching and encouragement. These in-class interactions with teams are moments where we meet the needs of specific students by clarifying a problem statement or reinforcing a course concept. Out-of-class, each reading guide lists at least two alternatives for practicing the concepts that are the subject of the next in-class lesson.

Assessment of Student Learning

I assess individual student learning with formative assessments (scored readiness assurance quizzes, graded daily homework problems, ungraded reflection prompts) and summative assessments (three one-hour midterm exams and a final exam). I assess team performance with formative assessments (readiness assurance quizzes, team application exercises). I composed all of the assessments. At the start of the semester, the students in the class reach consensus on the percentages that each category of scored assessment will contribute to the final course grade. Typical weightings are 40 % individual assessments, 50 % team assessments, and 10 % team contribution.

Lessons Learned

The Instructional Experience

Each semester, we include more variety in team application exercises. For example, the first time, nearly all application exercises were assessed by collecting team responses to multiple choice clicker questions. Now we use clicker questions with application exercises for approximately 30 % of the exercises. We have replaced clicker questions with team assessments like sketch a trend, draw and/or label a process diagram, *short* explanations, and *brief* presentations to the rest of class.

We have found that students are more likely to request a mini-lecture if we first offer a two min reflection activity. Most prompts give them a minute to write an explanation in their notebook, and then another minute to check their responses with their teammates.

The Student Experience

The course has varied feedback mechanisms to help students develop as learners and as professionals. Informal feedback from peers and the instructor every class session helps learners evaluate their preparation and study habits. Students report that their study skills improve throughout the semester. Several students comment that they changed their problem solving approach after listening to a teammate's ideas.

Every class session gives students practice at leading and collaborating collegially with a group of peers. On the course evaluations, most students express that they value this early team building experience and its importance to their future success at the university and in the workplace.

A Case Study on Engineering Ethics

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Instructional Context

Course Name and Description

Ethics and Engineering, a senior-level class at Texas A & M University, provides the theories, concepts, and tools that practicing engineers need to identify, analyze, and responsibly address ethical and professional concerns. Students are introduced to concerns that affect an individual engineer, including professional opportunities and obligations, employee rights and organizational challenges, and to the social and ethical dimensions of emerging issues such as globalization, privacy and security concerns, and environmental awareness.

Place of Course in Larger Program of Study

The course is required for all graduates of the Dwight Look College of Engineering because it satisfies part of the ABET (the engineering accreditation board) education criteria. It also satisfies two internal institutional requirements: it is a writing-intensive course and satisfies a Language, Philosophy, and Culture core requirement. The course is co-taught by instructors from the Department of Philosophy and the College of Engineering.

Learning Goals of the Course

Students who fulfill the course requirements should be able to:

- Know some common methods for identifying, analyzing, and resolving ethical problems.
- Develop the capacity to think analytically, critically, and creatively about ethical issues in engineering.
- Develop a basic understanding of ethical theories and how they inform engineering codes of ethics and common engineering practices.
- Know about classic and contemporary cases in engineering ethics and typical ethical and professional issues that arise in engineering.

- Know the codes of ethics and relevant laws that govern engineering practice.
- Improve oral and written communication skills.

Description of Learners

The 1400 students who took the course in academic year 2014–2015 were juniors and seniors pursuing undergraduate engineering degrees. Enrollment is expected to steadily increase as the College of Engineering executes its plan to double in size over the next decade.

Rationale for Flipping

Adoption of a flipped, hybrid model of instruction was driven by a desire for improved pedagogical outcomes, infrastructure and qualified faculty constraints, and a more invigorating and pleasant learning environment. We also envisioned that technological advances would allow us to offer tailored content and assignments based on student interests, which is impossible in large lectures. The lead author of this case (Miller) taught the course in a traditional format for two semesters before spearheading the development of the flipped course, supported by a competitive $75,000 internal grant and help from the university's Instructional Technology Support (ITS) team. He has since taught it in the flipped format twice. Flipping at this time also allowed us to capture the expertise of C. E. (Ed) Harris, recently retired, who started the course and is the first author on the leading textbook in the field.

Models and Theories Used to Guide the Flipping

Four principles were used to guide decisions about flipping: (1) the classroom should be a place for dialogue, not monologue; (2) it should be more student-directed and less instructor-directed; (3) faculty expertise should be primarily used to correct and extend understanding, not to introduce material; and (4) often, students will learn best when they alternate between active and passive learning.

Structure and Implementation

Structure of the Flipped Course

The course follows a hybrid structure. Each week includes 25 min of online content, one 75-min session with faculty that explicitly called F2F (face-to-face) to remind instructors and students that it is not a lecture, and a two-hours recitation of 25 students led by a graduate teaching assistant from engineering or philosophy. In academic year 2014–2015, each F2F session consisted of two faculty members from

philosophy, one from engineering, and 250 students. Starting fall 2015, each F2F session consists of no more than 100 students, directed by one instructor from engineering and one from philosophy, to comply with a college initiative to reduce class size. The course content includes three weeks on ethical theory, four weeks on microethics, and five weeks on macroethics.

Preparation of Learners for Participating in Flipped Instruction

During the first year we taught the flipped course, we explained its advantages over the traditional model on the first day of class. In the second year, we simply explained how and why the components of the class fit together and emphasized the importance of preparation. Each week during the semester, students receive an extended email that explains how the tasks for the week fit together. The importance of preparation is repeatedly reinforced through the online quiz assessments, which are worth 20 % of the student's course grade.

Description of In-Class and Out-of-Class Activities

The online sessions are video recordings of instructors or expert lecturers interspersed with images and graphics that include ungraded formative questions with extensive feedback called Knowledge Checks at roughly six-min intervals. Each session concludes with a graded quiz of 10 questions; students will have seen about half of the questions in the Knowledge Checks. They take serious students about 50 min to complete. Students are also asked to read textbook and supplemental texts, on which they take quizzes or write response papers.

The F2F sessions are split roughly evenly between discussion and the presentation of new material, i.e., similar to traditional lecture. The two activities are interspersed throughout the session, and the division naturally varies based on learning objectives, strengths of the faculty, and quality of student participation. Integrating the activities allows the content of the material to be determined and its presentation oriented by student struggles and interests, which is impossible with prepared texts or videos. It also allows students, working in small groups and guided by a TA, to think creatively by constructing their responses to questions, which are then examined by the instructors and other students, before learning expert, influential, or widely accepted views, and allows instructors to ensure that simpler concepts are mastered before more sophisticated ideas are scaffolded.

In recitations, students master material covered in online and F2F sessions, share their own experiences, especially those from their intern and co-op employments, apply and discuss different cases, and practice and receive feedback on their oral and written communication skills.

Tools Used to Support the Flipped Process and Learners

Online sessions were produced using Articulate Storyline with assistance from the ITS team, who also provided indirect support as students used the sessions. The online sessions are made available to students through eCampus and are integrated with its Grade Book. One part-time graduate research assistant spent half of his time managing online session access, answering student questions, and resolving issues and the other half assisting in the creation of new online sessions.

Differentiation of Instruction

The online sessions allow students to proceed at their own pace, with material presented in oral and written formats to permit a variety of learning experiences. Students receive specific feedback based on their answers to Knowledge Check questions. The flipped course includes more opportunities for students who struggle with a particular topic to ask questions of instructors or teaching assistants. We are currently in the process of creating online sessions specialized by professional society and industry.

Assessment of Student Learning

Students are evaluated similarly in the flipped classroom as they were in the traditional offering. Two exams are worth 40 % of the course grade, a series of writing assignments, culminating in a 2000-word peer reviewed essay, worth another 35 %, and a group presentation is worth five percent. The 20 % of the course grade now determined by the online quizzes took the place of traditional pen-and-paper quizzes and a grade for participation, which is now simply expected of all students.

Lessons Learned

The Instructional Experience

When planning the development of the online modules, we underestimated the time necessary to create appropriate questions and informative feedback for Knowledge Checks. These serve as an interactive commentary on what was presented and often corrected common misunderstandings. We also underestimated the precision of language necessary, which is closer to a written text than a casual explanation. We learned that 25 min (roughly four six-min parts) was approximately the right amount of online content for 75 min of F2F time.

We created additional online sessions after finding that students learned basic concepts faster and better through them than by reading assignments that imparted the same information. Student comprehension and retention of material mentioned twice (in different sessions or in an assignment and a session) was far higher than material that was just mentioned once. Perhaps in part because our class is required core course, the decision to make many of the transcripts available to all students was a mistake: too many students treated the online sessions like homework, using the transcript as a reference to find the answer, rather than internalizing the ideas or at least taking the active step of capturing important ideas in their own hand. This decision also led to a disproportionate number of inquiries about online quiz questions. The online sessions had been designed to use visual cues (important words, phrases, and images that were interspersed with speaker's face) to reinforce certain ideas, not to convey information as stand-alone texts.

The technologies and their integration were more robust than we had expected: we had far fewer technical issues than anticipated, given the size and complexity of the course and our "big bang" rollout, but technical constraints prohibited us from consolidating student performance on online sessions to tailor F2F and recitations.

The Student Experience

Student response to the online sessions was more positive than we expected. Students seemed to appreciate them, and several remarked that they would listen to challenging parts of the recording more than once. Serious students reported taking about 50 min to complete a session based on a 25-min recording, including about 20 Knowledge Check questions and 10 Grade Quiz questions. On a midterm survey, a majority (55 %) reported at midterm that they learned a decent amount or a great deal (four or five out of five on a Likert scale) from the online sessions.

According to anecdotal reports given by experienced TAs, the quality of student work has been higher across the board since the transition to the flipped classroom. An improvement in quality has been seen in short (750-word) papers and 2000-word essays in which students have a chance to demonstrate nuanced thinking about difficult ethical topics. These reports are supported by instructor observations in the F2F sessions and recitations, where discussions are more thoughtful and students more engaged, especially at the end of the 75-min F2Fs.

A Case Study on Engineering Thermodynamics

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Instructional Context

Course Name and Description

"Energy Fundamentals I" covers the integration of fundamental concepts from physics, chemistry, mathematics, and engineering within the context of energy applications. Principles governing energy transformations, transport, conversion, and laws of thermodynamics are covered.

Place of Course in Larger Program of Study

The course, enrolling 50 students each year, is a junior-level (third year), required course in the *Energy Sector* in the Department of Integrated Science and Technology (ISAT) at James Madison University. The course is considered one of the hardest in the curriculum based on student responses in pre- and post-course surveys, as well as evidenced through the literature (Ugursal & Cruickshank, 2014).

Learning Goals of the Course

The four overarching learning goals are to enable students to:

- Gain a thorough understanding of the basic definitions, concepts, and principles of thermodynamics
- Analyze thermodynamic processes and cycles within the conceptual frameworks of the First and Second Laws
- Apply the basic concepts of thermodynamics to the solution of practical problems
- Develop an orderly approach to problem solving.

Description of the Learners

Junior students taking this course have basic physics, mathematics, and chemistry knowledge.

Rationale for Flipping

Having taught a few versions of this course with both engineering and ISAT students using a traditional lecture-based model for about 25 years, it was not until the past two years that the course was flipped. Although learning still took place in the traditional lecture-based course, it was evident year-after-year that students were not coming prepared for class, they were not reading course content, and thus class time was spent on lecturing mostly with some discussion and limited interaction. The rationale for flipping was threefold: (1) we wanted students to take ownership of their learning and change their mentality that the ownership belonged to the instructors; (2) we wanted students to learn the content more deeply and to become better problem solvers; and (3) we wanted a more student-centered experience to enhance learning, but also to reduce the load on the instructors, who are assigned increasingly higher teaching loads each year.

Models and Theories Used to Guide the Flipping

The theoretical framework guiding this approach is cognitive apprenticeship theory (CAT) (Collins, Brown, & Holum, 1991; Rogoff, 1990). As a social cognitive theory, CAT posits that students learn from experts by observation, imitation, and modeling. The instructor(s) serve as coaches to bring tacit processes out in the open. In the course described herein, students spend more time observing and learning from the instructors. Coaching is more targeted and problem solving becomes an exploration where strategies are learnt, reflection is built in with student peers working together, and informed inquiry prior to coming to class enables scaffolding.

Structure and Implementation

Structure of the Flipped Course

It is important for students to ease into the flipped classroom. Thus, the course is broken into three parts. The first four weeks follow the more traditional lecture-based model in part because there is a lot of foundational knowledge that has to be gained (see syllabus in the appendix). The next seven weeks, representing the more applied knowledge translation modules, are flipped and involve prerecorded videos and questionnaires, Flip Lecture Sheets (FLS), which are completed before coming to class (see appendix). The last three weeks are focused on a project and knowledge application. Prerecorded videos are not used because knowledge gained throughout the course has to be integrated and applied to solve more complex problems. From start to end, students are given more ownership and responsibility in applying knowledge gains.

Preparation of Learners for Participating in Flipped Instruction

Given the course structure, students are eased in to the flipped classroom. Where they find some comfort in starting the class in a more traditional manner, they are slowly introduced to the concept of flipping and the motivation for flipping. During this conversation, students are informed of the benefits for them (referencing both the education literature but also past offerings of the course), the benefits to enhanced and deeper learning, and the benefits for the instructor/facilitator. After such a conversation and clear presentation of the expectation and structure, resistance is minimal or nonexistent.

Description of In-Class and Out-of-Class Activities

During the flipped portion of the course, key activities take place before, during, and after class. Before class and at least one week in advance, lecture notes are given to the students and prerecorded video lectures and FLS are posted on Canvas (the learning management system). Students are expected to watch the videos ahead of class. During class, students bring a signed hard copy of the FLS, which includes a list of questions students have related to the material covered in the videos, a signature acknowledging she/he watched the video, and feedback to continuously improve the prerecorded video. This submission counts as part of the students' homework grade. Approximately one-third of the class is focused on answering and discussing the questions submitted on the FLSs. The process involves identifying common themes and misconceptions. A second third of the class focuses on the instructor solving problems on the board and asking questions. The last third of the class, students work in small groups or individually to solve additional problems and even get started on the homework. After class, students are assigned homework. As for the semester project, students are asked to identify a real-world thermal-fluids system (i.e., related to their capstone, related to the type of work she/he wants to do in the future, or something of personal interest). The project is peer reviewed (see appendices).

Tools Used to Support the Flipped Process and Learners

The creation of videos requires a quiet space, good lighting, and the following equipment and systems: a computer, Microsoft PowerPoint, Camtasia Studio, a microphone with noise cancelation, and an Elmo. A good amount of time is needed to prepare effective slides, presentation flow, topic transitioning, and ultimately editing of the videos.

Differentiation of Instruction

Students enrolling in this course come with differing levels of knowledge and motivation. In terms of knowledge differences, the flipped classroom enables students to share their unique knowledge and misconception needs on the FLS submissions and allows all voices/perspectives to be heard. Content topics that are more complex and

students have more questions on result to more class time being spend discussing the misconceptions. Without the personalized feedback on the FLS submissions, individual needs would not be captured effectively. Further, in terms of motivation differences, the flipped classroom enables students to self-pace their learning both in-class and outside-of-class. In-class, students work independently or with a small group to practice problem solving and outside-of-class they work on their own in her/his select environment to complete homework, view videos, and complete FLSs.

Assessment of Student Learning

Student learning assessments involve homework, exams, quizzes, and the course project. These assessments are similar to what was done in past versions of the course when flipping had not taken place.

Lessons Learned

The Instructional Experience

Flipping one of the most rigorous and challenging courses in the curriculum has proven to be a rewarding experience for the students and the instructors. Students not only experience a different teaching style, but stronger engagement in class and outside. Being able to devote class time to answering questions and address misconceptions has proven to be a much needed aspect, which rarely occurred in the traditional lecture-based model. Spending more time in class to solve problems is also worthwhile. Students see the faculty experts solve problems and then practice solving problems too with the instructor present. The learning is deeper and more informative. The classroom atmosphere is more welcoming and engaging. Although flipping requires more time of the instructors and the students, it is well worth the effort. For the instructor, preparation time decreases over the years as flipped course materials improve.

The Student Experience

Upon flipping, it became evident that students come to class more prepared, with more questions, and more motivation to engage in conversation and work out problems. This enthusiasm continues all semester. Nearly all the students commented in course evaluations on the positive aspects of the flipped classroom and environment which they found to be either helpful or extremely helpful in mastering content. Themes that emerged in the evaluation included: (1) the ability to pause and replay videos was productive and led to deeper learning; (2) the lecture being more focused on application and practice was a strength; (3) the workload outside of class was demanding, but led to deeper learning; and (4) the classroom environment was conducive to learning and support from the instructor and peers.

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A Case Study on Mathematics

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Instructional Context

Course Name and Description

The *Discrete Math* course covers concepts of logic, modeling, and proof techniques. The course is seven weeks of teaching. The workload for the students is 140 work hours (includes class and independent work time). All marks are given at the final exam. To ensure steady work during the course, it includes mandatory homework submissions (these do not count toward the grade). The students' work must have been accepted in order for them to be able to take the final exam.

Place of Course in Larger Program of Study

Discrete Math, an elective course offered to students in their final year of their professional bachelor study in information technology or electronics at Aarhus University (Denmark) School of Engineering.

Learning Goals of the Course

Students must be able to define and analyze the fundamental concepts of propositional logic and predicate logic, explain and apply modeling using discrete mathematics such as sets, lists, functions, relations and graphs, and describe the principles of various proof techniques such as induction, contradiction.

Description of the Learners

The classes have had 35–50 students, all of whom are in the last year of study. Prior to this course, students have had two years of mandatory courses and a half-year internship.

Rationale for Flipping

The course has always been popular and the students did well. However, it was always the instructor (me) who simply talked and talked during class hours. The students seldom had the time to "speak mathematics," which is necessary since one of the most important learning outcomes is using mathematical terms and notation orally. I wanted the students to prepare so that they could use the time together with each other and me for discussions and argumentation.

My argument for flipping a classroom is the following: First, reduce lecturing and use time for talking mathematics among the students. Second, the students should be able to critique mathematical arguments. Third, students should see alternative ways to solve mathematical problems.

A bounding condition was that the facilities (rooms, allocation of hours, etc.) must not be changed. Preparation for the exam should be done along the way instead of students reading for 96 hours the last four days before the exam. Finally, I wanted to ensure that the students knew "the rules of the game."

Model and Theory Used to Guide the Flipping

I am a constructivist. A Danish pedagogical professor, Steen Larsen (1999), has expressed constructivism the following way: You learn something if and only if:

- You have to create something in a process.
- You have to be emotionally involved in your creation.
- This process requires skills that you almost meet.

As a consequence of this, I need to structure the time I spend with my students in a way so that they will work, and the work can be based on their individual competences. And that is not lecturing! Peer assessment and peer feedback is a model that enables students to be critical on mathematical solutions.

Structure and Implementation

Structure of the Flipped Course

The course runs for seven weeks, twice per week, each a four-hours session (56 hours total in-class time).

Preparation of Learners for Participating in Flipped Instruction

Teaching has a strong culture associated to it. So to help students understand the new approach, I send out an email before the class to describe the procedures.

Description of In-Class and Out-of-Class Activities

In a typical week, the course contained the following in-class activities: (1) general feedback on the assignment submissions (30 min, teacher and students); (2) highlight week's topics, application, and lecture (45 min, teacher); c) workshops (60+ min, students); (3) work with new assignment (60 min, students as guided by instructor); (4) students work in pairs to prepare exam question (45 min); (5) trial exam incl. feedback (~30 min, teacher and students). Except for the general feedback and brief lecture periods, all other activities in the class are made possible because of the flipped approach.

Prior to flipping the course, all marking of the mandatory assignments was done by a teaching assistant. So the students never critiqued mathematic work, they just solved problems and got feedback. When flipping the course, I decided to use peer assessment for the mandatory hand-ins. The students were allowed to work on their hand-in in pairs (since I want them to talk about math, doing it completely individual seems to be contra productive), but they should hand-in individually. Then they each have to critique three other students' hand-ins. In the first instance of the course, they were just asked to "critique" That was very difficult for them, so in the next instance involved detailed rubrics for each question—something the students found a big help when critiquing other students hand-ins.

As in many other flipped classrooms, I moved lecture time out of class by the use of videos. Discrete math is a standard topic, so there are many prefabricated videos describing the different topics. So that the students too bored with one style, I chose videos of different length and format, ranging from 10 min to more than one hour. All of the videos are all freely available on YouTube. Apart from the long recorded lectures, the students reported that they liked the videos.

Tools Used to Support the Flipped Process and Learners

The in-class activities took place in a standard room with chairs and tables. Most of the time, when the students worked together, they simply sat around the tables and discussed. It would have been nice to have a room with round tables (or just tables in groups), but the class worked well in our normal room with tables in rows.

Many examples of flipping includes that the lecturer produces video based material. I took a different strand; I used pre-produced videos freely available on YouTube. I used four types:

- 20–30 min PowerPoint cast on a given (larger) topic from Project Polymath
- Videos of teachers describing a precise topic on a board; typically 10 min long
- Short screencast; typically 10-min long from Grand Valley State University, Department of Mathematics
- Long, recorded lectures (one to one and half hours)

Apart from the videos, I created multiple-choice questions using our learning management system (Blackboard Learn) for the students so that they could check their understanding outside of class.

Differentiation of Instruction

Almost all textbooks on discrete math show only one solution to a problem. As a teacher, I can show more, but the students do not necessary engage whit the different solutions. By giving the students both the possibility to prepare by reading and by watching videos, the can see different ways to discuss math. And by letting them review three of their fellow students' submissions, they had to engage more actively in possible different ways to solve a mathematical problem.

Assessment of Student Learning

The exam is a 15 min oral exam where the students draw a topic and have 12 min to present this topic including a mathematic proof involving the topic. A topic could be "logic" or "sets". Then two other students critique the presentation, they have one and half min each for their critique. It is their (i.e., not the student presenting) ability to critique that is evaluated. A student's final mark is based 75 % on his presentation and 25 % on his ability to critique.

Prior to this course, students have experience with oral exams, but now there is the added critique. They need to practice the form to feel secure. Consequently, each week included a preparation of an exam question and an actual trial exam. The purpose was two fold: Firstly to have the students reflect on the topic and create their own overview of the topic. Secondly to have them prepare for the next activity, a trial exam. The trial exam should make the students "speak math" and train the in the new format.

Lessons Learned

The Instructional Experience

The course went well and it received good student evaluations, so why change? I have two answers: (1) I need to experiment with new ways of teaching, otherwise, I get worn out and uninspired when I teach. Hearing about flipped teaching seemed like fun—and it is! (2) Being a popular course by the students does not necessarily imply that the students learn much. They might be nicely entertained and the exam may be easy. My personal pedagogical viewpoint is constructivist, so "it is the one who does the work who learns."

Many of the flipped class implementations I have seen use videos the teacher have produced him or herself. This has some obvious advantages—I would be in full control of the material, I could relate it even better to engineering. It takes a lot more time to produce your own material. I feel that the possible quality enhancement I could have had by producing material myself does not match all the time I should have spent producing videos.

The next time I will try to have the students engage more in the video based material. I may use a tool like Zaption, which allows one to embed reflective questions in the videos. I do not plan to look at the answers. Rather, it will simply be something the student uses to change from passive watching mode to active thinking mode.

The Student Experience

A flipped course is different in nature than the traditional courses students have taken prior. In general the students liked the way the course was run: they appreciated the clear structure and rules. The mandatory hand-ins and the peer feedback on those were seen as the most important learning component.

In general the students like the video materials with one exception, a 90-min long video from the Massachusetts Institute of Technology. The students did not use the multiple choice questions. The first couple of weeks, the students answered the multiple choice questions. Later, they did not answer them; they found the other elements in the course to have a better learning outcome for them.

References

Allen, M., & Sites, R. (2012). *Leaving ADDIE for SAM: An agile model for developing the best learning experiences*. Alexandria, VA: American Society for Training and Development.

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American Educator, 15*(3), 6–11.

Csikszentimihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York, NY: Harper & Rowe.

Larsen, S. (1999). *Den ultimative formel – for effektive læreprocesse*. Hellerup: Steen Larsens Forlag.

Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology*. London: Routledge.

Michaelsen, L. K., Knight, A. B., & Fink, L. D. (Eds.). (2004). *Team-based learning: a transformative use of small groups in college teaching*. Sterling, VA: Stylus Publishing.

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. Oxford: Oxford University Press.

Sibley, J., Ostafichuk, P., Roberson, B., Franchini, B., & Kubitz, K. A. (2014). *Getting started with team-based learning*. Sterling, VA: Stylus Publishing.

Ugursal, V. I., & Cruickshank, C. A. (2014). Student opinions and perceptions of undergraduate thermodynamics courses in engineering. *European Journal of Engineering Education, 40*, 1–18.

Vygotsky, L. S. (1978). *Mind in Society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Flipping STEM

Abstract This chapter contains case studies from STEM content areas. Case studies in this chapter focus on the concept of discovery learning, incorporate constructivist principles, but also constructionist theories. Several cases reference the tradition of apprenticeship and research that shows the value of project work as a means to highlight the iterative nature of design, while maximizing in-class time with active learning through collaborative activities and personalized instruction. Each case study opens with the instructional context and a rationale for flipping the classroom. The case-study authors also describe the structure of the course, as well as descriptions about how they prepared their students for flipping, and an evaluation of the flipping experience from both the instructor and student perspectives.

A Case Study on Biology

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Instructional Context

Course Name and Description

BIO 93: DNA to Organisms is a first-quarter introductory biology course for majors at a large, public research university. Lecture size is about 350 students per section. Students also attend a discussion in groups of 30, facilitated by a graduate teaching assistant TA). About 1500 students enroll in the sections each fall.

L. Santos Green et al. (eds.), *The Flipped College Classroom*,
Educational Communications and Technology: Issues and Innovations,
DOI 10.1007/978-3-319-41855-1_8

Place of Course in Larger Program of Study

This course covers basic biological molecules, cell biology, energetics and genetics. The second course of their first year covers evolution, biodiversity and ecology. It is a required course for students who are pursuing a biology or pre-health degree.

Learning Goals of the Course

After completing this course, students should be able to:

- Explain basic concepts in cellular and molecular biology using correct terminology
- Correctly apply concepts to advanced questions
- Demonstrate scientific skills
- Practice self-regulated learning

Description of the Learners

The majority of our students are first-quarter freshmen. Most are high-performing, though many only had biology as a high school freshman. The average Math SAT = 537, Reading SAT = 489, 23 % have a passing AP Biology score. The class is 67 % female, 24 % minority.

Rationale for Flipping

As is common in very large introductory biology courses, many students do poorly in this course. Some struggle to learn basic material, others are excellent at basic memorization but cannot apply the basics to new situations. My primary work is biology education research, so I asked to teach a flipped version of Bio 93 for Fall 2012 to see if a flipped course would help less prepared students. I train graduate students to teach discussion sections, so I had a large selection of group activities that could work in a flipped lecture.

Model (s) and Theory (ies) Used to Guide the Flipping

Students created basic content notes and studied before class. Pre-class videos are instructor-made, short, and designed to focus on biology basics. Class time is focused on higher-level Bloom's Taxonomy activities of application and prediction. Most class periods present one scientific journal article. This course design was based on several theories of learning research:

1. Studying content before class time increases exposure to the material as spaced repetition

2. Focusing on research cases in class pushes students to work within their zone of proximal development, rather than focusing on memorized content
3. Multiple, cumulative midterms invokes the testing effect, increasing student memory and retrieval skill.
4. I also found that a flipped course allows me to focus on growth mindsets in my students. Class time is always spent on new situations, and students rarely feel smart and confident.

Structure and Implementation

Structure of the Flipped Course

The university is on a 10-week quarter system, with three midterms and a final exam. In order to match the other instructors, summative assessment is 80 % of the course. The remaining points come from clicker (i.e., electronic student response system) participation, online quizzes, discussion participation, and occasional class worksheet turn-ins.

Preparation of Learners for Participating in Flipped Instruction

I have found these students are not resistant to the idea of a flipped class. I take time during the first lecture to explain that I am not adding study time, I am just spacing studying so there is less cramming before the test. I have early deadlines to help me find the five percent of students who always have technology difficulties. I also have students show me or their TA their handwritten video notes early in the quarter so I can be sure they are actually doing that important work before class.

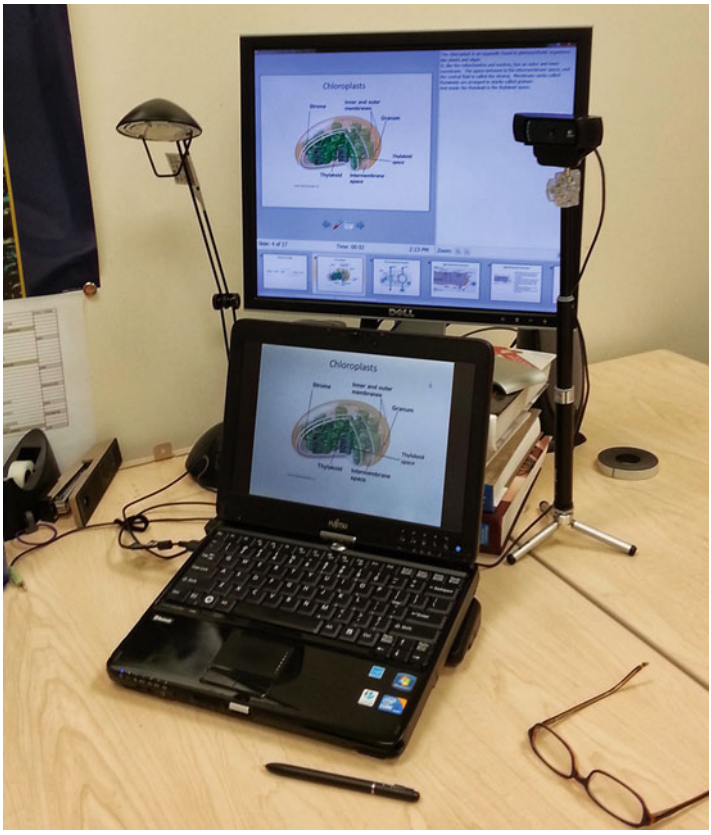
Description of In-Class and Out-of-Class Activities

Before class, students watch a short lecture video and take handwritten notes onto a printed outline with images. Videos require student use of the textbook for figure labels and vocabulary definitions. While videos were generally less than 10 min long, students reported taking one to two hours to complete the notes. They complete a basic five-item online quiz in our learning management system. Students also print and bring a two-page worksheet to class for the in-class activities.

Every 50-min class first used a low Bloom's Taxonomy level activity (e.g., compare-contrast, fill out a table, clicker quiz) to warm up. The main activity was then a series of problem-solving questions associated with a recent research paper. All problem-solving was done in student groups, with teaching assistants (TAs), peer tutors, and I circulating to offer support. Class activities were not directly tested. Instead, I emphasized that we were practicing the same skills that would be required on the exams, such as how to determine an experimental hypothesis based on a figure.

Tools Used to Support the Flipped Process and Learners

I converted all 25 lectures to video. Videos were made with a Windows tablet laptop (Fujitsu) with screen that accepts pen input, a second monitor, and a webcam on a small tripod. Lectures were built in PowerPoint, with my speaking notes entered in the presenter notes. For recording, I use Camtasia Studio. I have a webcam on a tripod that sits in front of a second monitor. I read the notes during the video, but because the screen with the notes is directly behind the camera, it almost looks like I am looking at the camera and just talking.



Differentiation of Instruction

Teaching a flipped class allowed two different types of differentiated instruction—out of class and in class. Students said that being able to rewatch the content videos at home until they understood the biology was very helpful. I had the videos captioned, which many students said helped them with the vocabulary and increased

their focus. In class, I had five TAs and four peer tutors circulating during group work. We could adjust instruction to help both low-performing and higher-performing students. On several days, an "exit ticket" clicker question was up on the screen, usually one with multiple right answers that required a solid understanding of the day's concepts. If a student group finished work early, they could answer the exit ticket and leave (or stay and help other students).

Assessment of Student Learning

Exams were all multiple-choice, and new each term. They contained much more research interpretation than exams in the more traditional lectures. Students would be presented with the main points of a new research article, and would have to interpret the biology and explain the new figures.

Lessons Learned

The Instructional Experience

I have now taught the class in a flipped format three times. Because I had the time available, I made a large number of changes to the in-class activities each time. Here is a short list of some main lessons I learned teaching a flipped lecture:

Flipping requires prepping both the lecture content and the class activities. It was more than twice as much work the first time through. I recommend not flipping a class until you have prepared regular lectures once, to get a better sense of what students do not understand.

Students indicated they really liked my videos because they knew exactly what I wanted them to know, which I expect would not have been the case if I had used preexisting videos easily found online. I do not feel videos are critical, however. Another instructor I worked with taught his section as a flipped/structured format using textbook reading guides. He very specifically indicated what students should read, and which figures were critical. So using readings instead of videos is fine, but students should end up with "lecture notes" after the reading so they have something appropriate to study.

Class time in a flipped lecture is very much like leading a 30-student discussion and less like giving a polished lecture to 400. I am moving from group to group, gauging how busy students are, recognizing and correcting common misconceptions, being enthusiastic, and recognizing when to move on. In general, a large flipped lecture is interesting and busy. It requires a willingness to make corrections and admit mistakes in front of students.

The Student Experience

In my class, students were quite positive about having the videos to watch and being busy in class. Their two biggest frustrations were as follows:

Successful in-class work required students to attempt to answer difficult questions on their worksheets, but students did not want to be wrong. They didn't want to ask for help, because that would be an admission of confusion. I found many students would just sit quietly with their worksheets hidden during an activity, and wait until I went over the answers. I told them I would NOT go over the answers to the activity, and they HAD to ask for help if they didn't know the answers (or come to office hours, or post the question anonymously on the class messageboard). They found this very frustrating, but we finally came to an agreement—If they were willing to try to answer the activities, I would give the answers in class.

Exams had much more experimental design and research figures than students expected. It was difficult for many to recognize that even though the things I did in class were not going to be on the test, they were the exact sorts of "puzzles" that they needed to solve in the exam. It was not until near the end of the quarter that students started regularly asking about these in-class application problems with the goal of being better "biological thinkers."

A Case Study on Calculus I

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Instructional Context

Course Name and Description

Calculus I is one of the largest courses being delivered by the Department of Mathematics at the university. The course covers topics including derivative, limits, and fundamental rules in integration. This case study targeted on the eight "flipped and flexible" sessions of *Calculus I*. In our case study, "flipped" refers to students watching online lectures before attending recitation sessions and participating in collaborative activities during the recitation sessions. "Flexible" means students could participate in the recitation sessions either by going to the classroom in person or through a Web-conferencing tool.

Place of Course in Larger Program of Study

The three-hours course credits serve to meet the Quantitative and Logical Skills category of the General Education Requirement (GEC) set by the university.

Learning Goals of the Course

The course goals are twofold: to cover the essentials and applications of one-variable calculus and develop corresponding problem-solving skills; and to develop quantitative and logical reasoning skills including the ability to identify valid arguments.

Description of the Learners

In fall 2014, a total of 256 students were enrolled in the eight flipped *Calculus I* sessions. The majority of students were freshmen and sophomores, and they were from all academic areas such as mathematics, business, biology, engineering and other similar majors.

Rationale of Flipping

This course has been traditionally taught in a large lecture hall with an instructor standing on the stage to deliver the content by using a chalkboard or a SMART podium. Students would listen, take notes, and sometimes ask questions in their seats. Such a traditional lecturing model has been continuously criticized for some of its limitations. For example, the high student to faculty ratio makes impossible to accommodate students' different learning characteristics and knowledge backgrounds. Instructor-students and students-students interactions in this course are extremely limited. Also, students often have difficulties to see and hear from the back of a large lecture hall. With the course content getting more and more complex through the semester, these problems become more salient. To solve these limitations, the flipped model was introduced.

Theory Used to Guide the Flipping

Guided by a constructivist theory of active learning (Jonassen & Rohrer-Murphy, 1999), eight sections of *Calculus I* were modified to a "flipped and flexible" format. It is believed in theory that moving the lower cognitive level content delivery (e.g., memorizing, understanding, and applying) to the pre-class work would maximize the in-class time for instructors to engage students in active learning through collaborative activities and personalized instruction.

Structure and Implementation

Structure of the Flipped Course

The "flipped and flexible" *Calculus I* is a 14-week course that consists of three online lessons and two recitation sessions per week, with a total 33 online lessons and 28 recitation sessions for the entire semester. The instructor creates a course site in the Desire2Learn learning management system where she uploads course materials and creates links to the homework system and the online discussion forums. During the semester, students engage in two major activities: (1) watching online lectures and finishing associated homework prior to the recitation, and (2) participating in the recitation and completed associated homework.

Preparation of Learners for Participating in Flipped Instruction

Before starting the course, students go through an online course-orientation, which explains how the flipped model works and introduces the course topics, learning goals, grades and grading policy, and expectations of participation and communication in the course.

Description of In-Class and Out-of-Class Activities

Every Monday, Wednesday, and Friday, students go through online pre-class lectures in their own convenience. Based on the instructor's teaching experience, these lectures are designed with the following sequence: first to present both concept and computational goals; second, provide a general introduction of the topic of this lecture; three, provide an instruction of various functions embedded in the lecture; and last, teach the topic by using a combination of short instructional videos, graphical representations, embedded quizzes, and associated homework. Students have options to watch the lecture whenever and wherever they prefer and also have options to stop and rewind the lecture until they understood the topic. Additionally, they can communicate with each other in the course online discussion forum.

Every Tuesday and Thursday, students attend in-class recitation sessions, where they can attend either online or in person. The in-class recitation session lasts 55 min and typically has around 30 students per class. The space is designed around pod seats and has three projectors that allowed for group presentations. In each session, the instructor first spends approximately 10 min to go through one or two warm-up examples related to the previous online lecture with the entire class and then breaks up the class into groups with three to four students in a group. Students typically form groups on their own based on their seating. Each group receives a problem handout and works together to practice the knowledge learned in the previous online lecture. After the group discussion on the problem, the instructor randomly chooses

a group to present their solution to the entire class, provides feedback to the solution, and then directs students to move on to the next problem.

For the online recitation sessions, students attend these sessions through a program called Carmen Connect. This program is a Web-conferencing tool that allows students to talk to other classmates through the computer headset microphone, chat in a text box, and work together on a common workspace on the computer. Students who use this program are also able to see the instructor's writing on the white board and hear him/her talk as well. During the group work activity, these students work on the same problem as presented in class but are only able to collaborate with peers who also attend online. In situations where there is only one student attending online, the student has to solve the problem without group work.

Assessment of Student Learning

Students in this flipped course are assessed by six components, including online homework (6.16 % of the total grade), online lessons (6.92 % of the total grade), recitation participation (3.08 % of the total grade), quizzes (6.92 % of the total grade), three midterms (46.2 % of the total grade), and a final exam (30.8 % of the total grade).

Lesson Learned

The Student Experience

Towards the end of the semester, students were asked to reflect on their learning experiences in this "Flipped and Flexible" calculus course. The majority of the students really liked this model and performed well in the exams. They believed that they have benefited a lot from the flexibility of the course. For example, they appreciated the flexibility of being able to watch the online lectures whenever and wherever that fit into their schedules and on their own pace. Also, the accessibility to the online materials was very helpful for them doing homework and preparing for the exams. However, several students in the course were not satisfied with their learning experiences and performed poorly in the course.

The Instructor Experience

To understand the different learning experiences in the flipped course, two surveys were sent out at the third and tenth week of the semester. Based on the survey results and eight class observations, three major implications can be drawn to guide future flipped class design and practice.

First, pre-class online learning matters. Students who fully completed online lectures and obtained higher grades in online homework were more likely to succeed in the course. However, not every student was good at regulating him or herself in watching the lectures and completing the assignments. Therefore, to help students focus and go through the online lectures, the instructor could make use of incentives. In this case study, the graded quizzes had been proven as an effective strategy to help students complete the lectures.

Second, students need the will to succeed in the flipped class. The more confident students felt in their abilities of learning math, the higher the grades they obtained in the exams. Therefore, students with high confidence in learning math are good candidate for taking flipped courses. For students with low confidence in learning math, instructors could verbally increase students' confidence by complimenting their growth, attributing the poor performance to the lack of effort, and encouraging them try harder.

Last, students need the skill to succeed in the flipped class. Students who were more willing to seek help from others achieved higher final scores in the course. For students who are not quite skilled to interact with help-seeking strategies on their own, instructors should provide additional support and create time and space to facilitate students' use of the help-seeking strategy. For example, in the pre-class learning, instructors could create a course online discussion forum to enable and encourage students to ask and answer each other's questions regarding online lectures by giving extra grades. For the in-class learning, instructors could pay more attention to those who are not engaged in the group activity, provide individualized instructions on the content, and encourage them to work together with group members.

In summary, the evaluation of the case revealed that successful students in the course were those who completed online lectures and mastered the content, were confident in their math learning abilities, and were skillful of seeking help from others while encountering obstacles. Thus the case study suggests that instructors should integrate design strategies to support students' pre-class learning, their will and their learning skills in flipped classes.

A Case Study on Computer Graphics Technology

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Instructional Context

Course Name and Description

Fundamentals of Imaging Technology (FIT) is a three-credit-hour in the Computer Graphics Technology (CGT) program within the Purdue Polytechnic at Purdue University. During approximately 16 weeks, students internalize the creative process and its phases through five projects aimed to create communicative digital images for industry and to apply, analyze and compare attributes of imaging technologies.

Place of Course in Larger Program of Study

The CGT program includes a number of specializations, including Web, Human Centered Design and Development, Animation and Gaming. FIT is a freshman introductory course, designed to provide basic skills applicable to all specialization areas.

Learning Goals of the Course

FIT develop basic graphic design skills, including the ability to visualize and communicate through images, and an understanding of basic design elements such as typography, shape, colors, and organizational principles. Additionally, FIT aims to develop students' understanding of the applications of Digital Art in today's world and guide them to explore careers in this field.

Description of the Learners

FIT is designed for students who are majoring in computer graphics and adjacent fields, as well as others who may have an interest in this topic. The majority of students arrive with a strong desire to learn digital imaging and image processing software as a stepping-stone to their dream career in animation, film or video games, although many have limited or no background in working with digital images and art.

Rationale for Flipping

FIT instructors noticed that many students struggle with their coursework, and, more concerning in an artistic field, were reluctant to "bend the rules" or explore creative applications beyond what was required. Personal experience and anecdotal evidence led instructors to suspect this may in part be due to the traditional lecture-and-lab approach that lacked opportunities for individual mentorship, in-class

individual and group projects to unleash students' talents, or opportunities for peer critique.

In Fall 2014, the instructor (first author) attempted to implement a studio model within the existing constraints of a course taught by large lecture plus a two-hours weekly lab. Weekly live demonstrations of targeted skills and video recordings posted afterwards on an online repository were used to introduce new skills. TAs provided one-on-one mentoring during labs. Group critiques occurred at the end of the semester.

Although overall satisfaction increased, students indicated in course evaluations that class time could be used better, with more in-class work and feedback time. Students found in-person lectures unnecessary, although they appreciated on-demand video demos. While they appreciated the end-of-semester project critique, they wished critique had occurred throughout the semester.

Models and Theory Used to Guide the Flipping

For many centuries, art was taught through apprenticeship at a Master's studio. Today, most art programs utilize mentorship-based studio classes. Teaching largely occurs through formal and informal critiques (reviews of in-progress or completed student projects) by instructors, and informal peer and group critiques. Through project work, students become aware of the iterative nature of design, and the (sometimes frustrating) nature of the creative process (Cennamo & Brandt, 2012).

In an attempt to maximize in-class time, we combined the studio model with a "flipped" classroom. While research on flipping college arts and humanities courses is at its inception, we decided to focus on the foundational principles behind the "flipped" methodology, by offering outside-of-the-classroom instruction via topical videos (Bergmann & Sams, 2012; Goodwin & Miller, 2013; Vaughan, 2014). This would allow students and instructors to use "lecture" time to cover strategies and techniques appropriate for students' individual projects, discuss issues, and to collaborate, create, and iterate.

Structure and Implementation

Structure of the Flipped Course

Each session included interactive studio activities. Students watched videos before or after class. Lectures were replaced with collaborative time, allowing students to work in teams for peer-learning and critiques. The instructor and teaching assistants (TAs) provided one-on-one mentorship. Project iterations could be resubmitted after changes based on peer review.

Preparation of Learners for Participating in Flipped Instruction

Scaffolding student learning and helping them stay on-task at home proved to be important. The syllabus included a weekly calendar, list of videos to be viewed prior to each class meeting, and additional learning resources to support student learning outside the classroom. We introduced students to the flipped format through a detailed description and a video during the first week of the class.

Description of In-Class and Out-of-Class Activities

Each session, the instructor offered a brief summary of the online lecture and an in-class exercise to practice new concepts. At this time, students could also ask the instructor to clarify challenging techniques taught in the video, or explore the topic further with instructor support and immediate feedback. The rest of the class time was devoted to independent or group work and peer critique, following the studio model.

Tools Used to Support the Flipped Process and Learners

One concern in "flipping" the classroom through video presentations was providing sufficient video resolution to illustrate the subtleties of image treatment or computer drawing. Videos were made in high definition (HD) and available for streaming on a separate course site designed for HTML5-enabled browsers (http://snebtor.org/digital-imaging). Course projects, assignments and grades were hosted through BlackBoard.

Differentiation of Instruction

Understanding that students learn at different paces and that online videos may not provide sufficient support for some students to master graphic design skills, teaching assistants were available for one-one-one tutoring and mentorship. Time freed from lecturing during the class allowed the instructor to provide individual feedback to students throughout the class—an advantage taken by the majority of students in the classroom.

Assessment of Student Learning

Assessment was conducted using a three-step approach that supported development of creativity and risk taking. First, students were asked to provide peer critique during the class using a rubric. Providing written feedback ensured that students had a chance to formulate their feedback thoughtfully, and provided peers with a written

record that could be used for redesign. Next, the instructor provided feedback. Finally, students had a chance to incorporate all feedback received and submit the artifact along with a reflection on the creative process and redesign for their final grade. To ensure smooth progression through these steps, sufficient time was provided between the critique session and final due date.

Lessons Learned

The Instructional Experience

Instructors initially feared that students would not attend the in-class sessions because content was available online. However, this did not prove to be the case. Students were eager to improve the quality of their projects. Through group work and peer critiques, students went from passive listeners to active participants who learned from one another, forming a community of engaged learners. The instructor's time was used for group or individual questions rather than lecturing on course content. One-on-one mentorship by the instructor and TAs enabled students to push themselves and the quality and complexity of student projects improved. Students learned to communicate with images to a higher competency level than in previous course iterations. The instructor felt well connected with the creative process of students. Teaching was no longer a tedious repetitive task, because the experience allowed the instructor to meet specific needs of each group and enjoy watching and guiding students in their development throughout the semester.

Based on the positive feedback received from students and the overall success of the class, the next course redesign will utilize a fully combined studio and "flipped" classroom approach. The same space will be used for all class sessions, with no artificial lecture and lab divide. Short instructional modules will be added as needed. Mentorship will be expanded by involving more instructors and TAs, and increasing the number of sections to allow for smaller cohorts. These modifications require major institutional changes, and we are excited to have been given the opportunity to transform the foundations class to a more active approach.

The Student Experience

The benefits of the merged studio and flipped classroom approach did not go unnoticed by students. Many shared that they found the videos helpful in mastering skills, which were further enriched by in-class activities, immediate feedback from the instructor and TAs, and peer critique. Students indicated that the ability to repeatedly review videos on demand helped them feel in control of their learning. Students felt that both the instructor and TAs were much more involved than in other courses, creating a rapport that was somewhat unprecedented for this class. However, students

and instructors alike felt that the divide between lecture and lab time was artificial, and that the course experience could be further improved by providing project work time and mentorship during all class meetings.

A Case Study on Computer Science

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Instructional Context

Course Name and Description

Introduction to Computer Science and Web Programming provides a broad overview of computer science while utilizing HTML and JavaScript to introduce beginning programming skills and concepts.

Place of Course in Larger Program of Study

This introductory service course is designed for non-computer science majors, and those considering computer science as a major.

Learning Goals of the Course

The learning goals of this course include:

- Explain the historical background and technology that led to the development and growth of computers and the Internet.
- Identify, compare, evaluate, and use language constructs in HTML in designing Web pages that include text, sound, images, and data structures.
- Identify, compare, evaluate, and use elements of HTML forms and JavaScript to make Web pages interactive, and to give data-processing capabilities to Web pages.

Description of the Learners

Students range from freshman to seniors. The majority of students are required to take this course for their (non-computer science) major or minor. Some students who are considering computer science as a major take the course to see if they will like it.

Rationale for Flipping

As I started teaching college-level computer science courses, I quickly realized that if students do not complete the assigned homework and projects, they generally struggle grasping and remembering the concepts I present in class. I started including activities in class that forced them to spend more time on the task of programming, and perceived a general improvement in student learning. This was the beginning of the path that ultimately led me to utilizing flipped classroom pedagogy. Flipping tends to force this practice since the students spend most of the classroom time working through reinforcement activities.

Model (s) and Theory (ies) Used to Guide the Flipping

Based on constructivist learning theories, I draw heavily on learner-centered traditions such as inquiry- and problem-based learning, providing students opportunities to expand their knowledge, supported by scaffolding. Students work in small groups, providing support to others, and building community. Application and problem solving occur during class, based on foundational knowledge acquired outside the classroom.

Structure and Implementation

Structure of the Flipped Course

In addition to almost daily programming activities, I deliver a few short "traditional" lectures in the classroom. These lectures however, usually include some sort of memorable demonstration, such as tearing apart a phone book to illustrate a binary search. I assign six individual projects that the students work on outside of class time, and one group project at the end of the semester that utilizes all of the semester's content. There are also two exams and a final exam during the semester.

Preparation of Learners for Participating in Flipped Instruction

On the first day of a semester I briefly describe that we will have small group, in-class activities instead of traditional homework, and that I have provided access to videos in Blackboard, our learning management system. I also explain research has shown that flipping a course can have positive effects on the students' learning outcomes. Further, I explain that it is more important than usual that they read the textbook and watch the videos before coming to class because that is the only way they will be prepared to participate in the in-class activities. Throughout the semester I periodically remind the students that they must come to class prepared if they expect to succeed. I explain that I am not going to hand them their "learning on a

platter," but rather that they are going to have to work at it a bit more than in most other classes. But I also explain that I will provide a learning environment where they can better succeed, provided they come to class prepared.

Description of In-Class and Out-of-Class Activities

Before class, I expect students to read the textbook, and watch related videos I make available through Blackboard. To encourage this pre-class activity, and to assess their level of understanding of the material in that day's in-class activity, I administer a short clicker-based (i.e., electronic student response system) quiz whenever we start a new chapter. These quizzes are scored based on correctness, but only 70–80 % of the questions must be answered correctly to earn full credit for the quiz. If a significant percentage of the class struggles with a question, I spend a few minutes explaining that topic or skill before starting the day's in-class activities. These clicker quizzes—which comprise five to ten percent of the final course grade—are meant to encourage students to attend class, and be prepared by having read the textbook and viewed the videos.

To provide active learning opportunities instead of classroom lectures, I develop in-class programming activities that reinforce the material provided outside of class. On activity days, the students self-form groups and collaboratively work on the day's activity. When I first flipped this class, I had students form groups of three to five participants. Recently, I have found that pairs of students work well, utilizing pair programming. See McDowell, Werner, Bullock, and Fernald (2006), Shore and Warden (2007), Simon and Hanks (2008), and Porter, Guzdial, McDowell, and Simon (2013) for a description of pair programming, and research supporting its use.

While the groups are engaged in the activity, a graduate assistant and I walk around the room to monitor progress, and to answer questions as they arise. My intent is to make the activities challenging for all, but possible for the best groups to complete in the provided class time. At the end of class, the students are encouraged to electronically share the solution so that everyone has access to the day's work. All students are expected to complete and submit them in Blackboard.

Tools Used to Support the Flipped Process and Learners

I self-record and edit videos for a majority of the course's content, and provide student access to them through Blackboard. By using a webcam, and TechSmith Corporation's Camtasia® on my notebook computer, I can record videos at any time and place at my convenience. I record most videos in my office, capturing what is being displayed on my computer screen, my voice, and a "head shot" of me. When the video is produced, the head shot is usually displayed in the corner of the video. I choose to self-record videos, rather than utilize prerecorded resources on

the Web, as I feel it important to provide a personal link with the students, and it provides me complete control over the content presented.

I utilize an electronic student response system (i.e., clicker). Clickers are the size of a television remote and have buttons a student uses to respond to questions I pose. I collect student responses wirelessly via a receiver connected to my computer, and then can easily display results immediately. I use clickers to quiz students, gather opinions, and gauge student understanding.

Differentiation of Instruction

By having students work in pairs many of their questions can be answered by their partner. The act of explaining a concept seems to reinforce their understanding of the material. When a pair is stumped, the graduate assistant and I are in the classroom to address their question. I always encourage students to come to my office when they have questions, or feel they are not understanding the material.

Assessment of Student Learning

I did not substantially alter my formal assessment of students when I flipped the course. However, I conduct much more informal student assessment in the classroom while they work on the activities than I could ever hope to have, if I had not flipped the class.

Because of the volume of students and activities, it is not practical to evaluate every activity submission from every student. Most submissions are not graded for accuracy, only that they submit something. Sporadically, I do evaluate a few of the activities for accuracy, and award three to four times as many points for those activities. This keeps the students on their toes because they do not know when I will grade for accuracy, and thus they have to always submit completed solutions, just in case.

Lessons Learned

The Instructional Experience

During six semesters of flipping this course, I learned the following.

- Recording and editing videos take much longer than I expect. Videos do not need to be perfect, since I am not perfect in a lecture either.
- I need one instructor or assistant per 10–15 students in the classroom, so students do not have to wait too long to get questions answered during activities.
- Students want credit for the work they are doing (e.g., group activities), even if it is just a couple of points.
- The flipped classroom will be a new experience for most students. Many will need help understanding how to be successful in it. Students who do not want

to make an effort will likely do worse than in a traditional lecture-based course.

The Student Experience

A sampling of responses from student surveys include the following.

About videos:

> It left time in class to explore the concepts in a practical manner.
> They were more personal than others because using his face in the video made it feel one-on-one. It also helped me understand material better.

About in-class group activities:

> They encouraged participation in class and with classmates.
> Group activities make the class more engaging.
> Could learn off of other students in class. Reinforced understanding of concepts. Developed team-work skills.
> Feels like I am learning, not memorizing.
> My preferred way to learn CS by far.

A Case Study on Computing Science

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Instructional Context

Course Name and Description

Computing Science 174, *Introduction to the Foundations of Computation*, *Part One* (CMPUT 174) is an introduction to programming and computational problem solving using Python. It uses computer games (Pygame) for problems, assessments, and laboratories.

Place of Course in Larger Program of Study

After CMPUT 174, students can take a typical sequence of courses on data structures, algorithms, and higher-level Computing Science topics.

Learning Goals of the Course

The student learning goals in CMPUT 174 include solving computational problems by designing, writing and running games written in Python. Students learn a three-step process: design, program and reflect. This process also applies to a wide variety of other computational problems. The students learn control structures, iteration, data structures, abstraction, and design/code quality in a way that makes learning other programming languages easier.

Each game is developed using multiple versions, with their own design-program-reflect cycle. Each version adds new features and quality requirements to mimic real-world software development cycles.

Description of the Learners

CMPUT 174 assumes no programming experience and is taken by students with different backgrounds. A total of 152 students (19 % CS majors, 41 % other science, 40 % other faculties), taught by Szafron and Ahmed, completed the pilot in January-April 2015.

Rationale for Flipping

Flipping uses face-to-face time for interactive problem solving. Computing science is a constructionist activity, with designs and programs as artifacts. Flipping supports an apprenticeship model where students learn the problem-solving process in class with an experienced mentor (the instructor), before attempting the process in labs (with teaching assistant support) and online (alone or with classmates).

Model (s) and Theory (ies) Used to Guide the Flipping

Our flipping is based on problem-based learning models grounded in constructivist and constructionist theories. Constructivism is a theory of learning where students actively construct knowledge as opposed to passive receiving of information (Ben-Ari, 2001; Machanick, 2007). While constructivism focuses primarily on cognitive aspects of learning, constructionism focuses on the learning that occurs when learners are engaged in “doing” and “building.” Both constructivist and constructionist theories of learning support problem-based learning models that promote deeper understanding and provide greater motivation for learners (Kay et al., 2000; O’Grady, 2012; Savery, 2015).

Structure and Implementation

Structure of the Flipped Course

There are three course components: online, face-to-face, and laboratory. The weekly cycle starts with students viewing videos and solving one problem component, that is submitted for low-stakes formative assessment. Then, the class interactively solves this problem component, plus the remaining components of the same problem iteration. A new problem is started when the last iteration of the previous problem is complete. Therefore, the timing of the online and in-class activities is highly dependent. Each student also works with a peer in a weekly three-hours lab with 20 other students.

The problem-based approach asks interactive questions at the broadest level (e.g., how do we analyze a game to construct a robust description?); at the specific level (e.g., what kind of programming component should we use here?); and everywhere in between (e.g., what type of object should we use to represent players' scores?). The incremental and iterative nature of problem solving, with unavoidable false starts, problem misunderstandings, nonoptimal design choices, errors, and diversions, is difficult to teach via traditional lectures, but must be learned by apprentice software developers.

Preparation of Learners for Participating in Flipped Instruction

Prior to the first course meeting, students access introductory videos and readings that explain the course structure, course material and the learning management system (Moodle). Students are also given a set of videos that explain the expectations for the flipped class. From day one, instructors continually highlight the critical importance of completing the online work prior to attending class as preparation for interactive engagement within the face-to-face class.

Description of In-Class and Out-of-Class Activities

Before face-to-face classes, students view traditional lecture material online as videos, presentation slides, and written documentation. Students attempt to solve one component of one problem version before class—it may be a design, program or reflection. This provides more than superficial knowledge of the component, and allows them to experience success and failure in trying to apply known concepts to a new problem component and in seeking new concepts where known concepts are insufficient to solve the problem. This motivates students and generates relevant questions for the class.

In class, the instructor guides the class with questions and enters text into Google Docs or enters code into a Python interactive development environment, projected onto a screen. The class "calls out" suggestions, points out mistakes / oversights,

or asks clarifying questions. This approach is analogous to pair programming in which professional software developers work side-by-side. One developer enters text and/or code, while both developers verbally discuss solutions, pick a solution, and decide what to type for this solution. The motivation for pair programming is that two developers working simultaneously can improve each other's good ideas, resolve each other's misconceptions, fix each other's errors, and learn from each other.

The students also work in two-person laboratory teams, supervised by a graduate teaching assistant for three hours per week on a problem that uses the same concepts and techniques being used that week for the online/class problem components.

Tools Used to Support the Flipped Process and Learners

Moodle is used to organize activities and direct students. Students watch videos and download static slides for each activity (designing, programming, and reflecting) of the application creation process. The videos are screencasts of static slides with spoken explanations and post-production annotations that incorporate animation and highlighting to focus student attention. Students access Google doc templates for each component of the application-creation process, ensuring format consistency. Many students use Google Docs on laptops to create design and reflections live during classes in parallel with the instructor. Most students download a virtual machine which is compatible with the laboratory and in-class programming environments.

Differentiation of Instruction

Students access pre-class material in video and slide format. The videos provide text, formulas, diagrams, spoken explanations, annotations and animations to cater to a wide range of learning preferences. Online activities include the creation of designs, programs and reflections, which provide a kinesthetic experience, augmented by instructors who interact with simple real-world props to explain concepts.

Assessment of Student Learning

Students are motivated and encouraged each week by a low-stakes formative assessment problem, accompanied by a detailed rubric that allows students to follow the assessment. Students submit a weekly lab and complete one midterm, one lab exam, and one final.

Lessons Learned

The Instructional Experience

Teaching a problem-based blended-learning course is challenging. The classic linear lecture with pre-completed solutions is familiar and comfortable. But, solving a problem live with 100 students "looking over your shoulder" can be challenging. Solving it using only concepts and techniques that are available at a particular point in the course makes it more interesting. Solving it while taking suggestions from students can make it very daunting, especially when your goal is to encourage broad participation by not discouraging students from offering solution ideas, no matter how divergent they may be. Teaching this way requires a certain fearlessness to handle the unknown and humility to make many mistakes without becoming flustered.

Our suggestions for success include: (1) thorough preparation of the current problem component, (2) understand how each component fits within the overall course and learning outcomes, (3) understand the specific techniques and concepts that can be used to solve the problem component at particular parts of the course, (4) forethought about what approaches students may suggest, and (5) guide students to feasible solutions and deflecting them from unfeasible ones.

The Student Experience

Student surveys indicate high satisfaction. There are two key improvement lessons. First, some students did not complete the preparatory material (a common problem in most blended courses) despite encouragement and some mark credit. Instead of increasing assessment stakes, we will try to make the material more engaging. Second, some students did not fare well in a problem-based format that sometimes discovers new concepts and techniques during problem solving. We have decided to provide a complete set of expository material, and encourage students who need it before the in-class problem-solving sessions to make use of it.

A Case Study on Mathematics

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Instructional Context

Course Name and Description

The very first course all bachelor students in business and economics at Maastricht University take in the first eight weeks of their first term is *Quantitative Methods I* (QM1). This QM1 course is a mandatory introduction into mathematics and statistics, covering topics from calculus such as differentiation and optimization of functions, and statistical topics such as hypothesis testing and confidence intervals. The course is characterized by several uncommon properties, like combining large scale (yearly inflow of 1100 students) with small scale (main educational unit is the tutorial group counting 14 students) features, strong international focus (only 29 % national students), and prior schooling and prior knowledge of students being strongly diverse.

Place of Course in Larger Program of Study

Bachelor programs for studies as business and economics are, in most of Europe, three-year programs. In Maastricht, the first year program consists of eight multidisciplinary courses introducing students to the main business and economics topics. QM1 and QM2, the intermediate level quantitative methods course, are part of this mandatory sequence of first year courses.

Learning Goals of the Course

In this sequence of methodological courses, the position of QM1 is a very unique one, due to strong heterogeneity of students. Different from practices in open academic programs, as existing in Anglo Saxon educational systems, university programs in the Netherlands (and most of continental Europe) are fixed. Streaming of students on the basis of prior education or knowledge is not admissible in such a constellation, and issues of heterogeneity need to be solved differently. The prime goal of this introductory course is therefore to strongly reduce the level of heterogeneity, to create a common methodological foundation all later QM courses can build upon.

Description of the Learners

Diversity is the key description of the students entering the QM1 class. Students are of more than 40 different nationalities, mostly European. Secondary schooling systems demonstrate strong differences, in terms of number of subjects taught in senior high school (last three years) and the level of coverage. Zooming in on the prior schooling relevant to the QM1 course, in some European secondary schools,

statistics is included in the mathematics curriculum, and in others, only probability. In some instance, neither is included. On top of these national differences, most European countries distinguish three different levels of secondary mathematics education: advanced level preparing for science and technology studies, intermediate level preparing for social sciences, and basic level preparing for arts and humanities. One-third of our students is educated at advanced level, two-thirds have taken courses of intermediate level.

Rationale for Flipping

From the very start of the business and economics school, 30 years ago, all education has been organized according problem-based learning (PBL) principles. As clarified in the next section, that model implies flipping with a restricted collection of learning resources. About 12 years ago, the degree of internationalization and with it, diversity in the student population, became so strong that a richer set of learning resources allowing for more diversity in independent learning was required. At that moment, e-tutorials were introduced.

Model(s) and Theory(ies) Used to Guide the Flipping

PBL is the prime instructional format used by all schools of the Maastricht University. Students meet in small (14 students) tutorial groups with the aim to solve staff designed problems. They do so using the Maastricht seven-step approach: clarify difficult terms, define the problem, brainstorm, taking stock and analyzing possible solutions, formulate learning objectives, self-study, and post-discussion in a second meeting, solving the problem task. The most important step of the learning process, the actual learning itself, does not take place in these sessions, but during the self-study step, in an attempt to collect all knowledge required to solve the problem task with the help of selected learning resources.

Structure and Implementation

Structure of the Flipped Course

Problem tasks designed for the QM1 Course are at the level of the final course goals. In order to be able to solve these complex tasks, (most) students will need to prepare by working through a sequence of intermediate tasks, available through the e-tutorial system (and alternative learning resources).

Preparation of Learners for Participating in Flipped Instruction

Student preparation is twofold. First, a voluntary summer course is installed focusing on prospective students with weaker mathematical background. Given the large share of international students, this summer course is fully online, and makes use of the same digital tool as the course QM1 itself: MyMathLab. However, the content of the summer course is of foundational type, covering most topics included in a senior high school program at advanced level.

The second component of student preparation consists of PBL training, which students receive in the first three weeks of university. The training is directed at skills for independent learning outside tutorial groups with the help of learning resources, and skills for collaborative learning within tutorial groups.

Description of In-Class and Out-of-Class Activities

In-class activities are restricted to pre- and post-discussions of problem tasks, with the aim to motivate students to set learning goals for their independent self-study. In the post-discussion session, in providing the solution of the problem tasks by students, all students check their level of mastery, and can ask for additional explanations by other students (or in exceptional cases, the tutor) if they judge their own understanding to be incomplete.

Tools Used to Support the Flipped Process and Learners

Classical learning resources in the PBL system are collected in the so-called study-landscape: a special section of the university library, containing many learning spaces for independent learning, and a large collection of textbooks, research literature, and videos as learning resources for independent learning. This collection of resources has been complemented, and to a large extent substituted, by the e-tutorials MyMathLab and MyStatLab, and by publicly available resources, such as the Kahn videos.

The e-tutorial systems MyMathLab and MyStatLab are generic digital learning environments for learning mathematics and statistics developed by the publisher Pearson. The MyLabs are primarily environments for short task-related instructions, practicing and self-assessment. Each step in the learning process is initiated by submitting a mathematical or statistical task. Students are encouraged to (try to) answer each (sub)question (See Fig. 1 for an example). If they do not master a question, the student can either ask for help to solve the problem step-by-step (Help Me Solve This), or ask for a fully worked example (View an Example). After receiving this type of feedback, a new version of the problem loads to allow the student to demonstrate his/her newly acquired mastery. When a student provides an answer and opts for “Check Answer,” a third type of feedback is provided (Fig. 1).

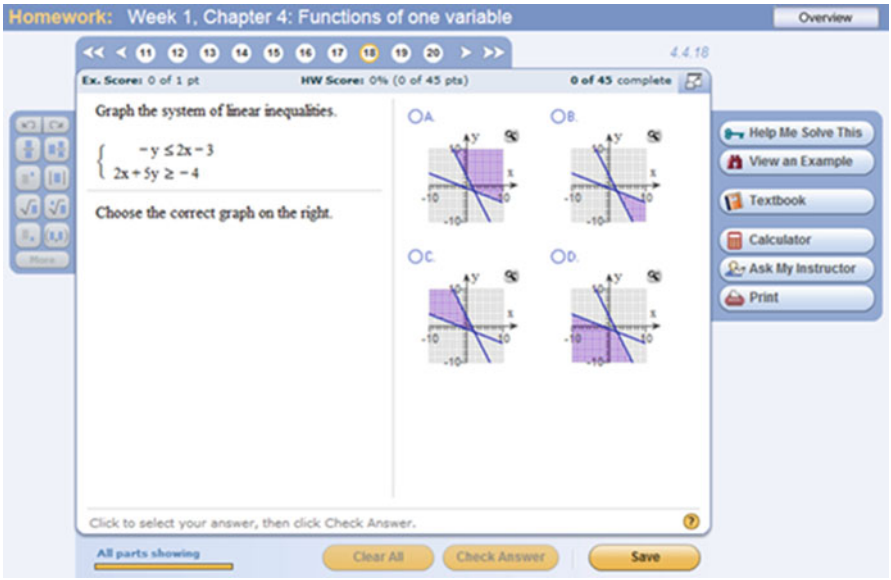

Fig. 1 MyMathLab task and its three feedback options: Help Me Solve This, View an Example, Check Answer

Differentiation of Instruction

Before introducing the MyLabs as learning tools, PBL tutorial sessions were accompanied by practicals, in which students would individually solve problem sets, assisted by a teaching assistant who, on call, would provide feedback in the solution of any task. These practicals have been replaced by independent learning and practicing in the Mylabs. All students working in the MyLabs work on the same problems: there is no differentiation in the level of the (final) tasks (by consequence of teaching all students to the same level, without streaming). However, differentiation is in the learning path, and especially in the type and multitude of feedback triggered by the student.

Assessment of Student Learning

Main assessment in the Maastricht PBL system is the traditional, cognitive oriented written exam. Although different assessment formats would better align with the learning principles of PBL, all schools of the university were challenged to prove that students educated in the PBL system perform as well as students educated in more traditional systems, also along standards of traditional assessments. In the QM1 course, these final exams are supplemented with three quizzes that allow students to score a small bonus. So although quizzes are primarily meant to inform students about

where they stand in their mastery of the learning goals of the course, they are not completely formative, but partly summative. Quizzes are administered in the MyLabs, and constitute similar tasks as students encounter in the learning mode. A bonus score is based on performance in the three quizzes, with some compensation for students who perform at a lower level in the quiz mode, than the learning mode.

Lessons Learned

The Instructional Experience

Differentiation in mathematics education in European secondary schooling is quite strong: differences between advanced and intermediate levels are so large that bridging the gap within a short eight weeks course is a very challenging task. In combination with the voluntary summer course, that challenge is satisfied for nearly all students with a weaker mathematics profile, and without such summer course preparation, for a majority of these students.

The Student Experience

Mathematics and statistics are service courses for business and economics students, and even of the hardest type that exist. A weak mathematical background is typically the product of less favorable attitudes towards math developed during high school, making the task students face a formidable one: a very intensive learning effort in two subjects one would never opted for, if not mandatory. The only circumstance that makes this sour apple acceptable for most of the students is that learning is fully personalized and student-directed. “I would not have made it without the patient support of my MyLab,” as one student expressed this.

A Case Study on Paleontology

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Instructional Context

Course Name and Description

Life through Time: *DNA to Dinosaurs* is an introductory-level, general education course at the University of Kansas (KU). Formerly a chronological march through geologic time and the fossil record with an emphasis on memorization, the flipped course teaches basic paleontology and geoscience concepts through the lens of complex, interwoven natural and societal events.

Place of Course in Larger Program of Study

This course is not required of geology majors, thus most students enroll to satisfy elements of the KU Core, a series of university-level course distribution requirements. *If taken with an introductory geology laboratory course, DNA to Dinosaurs fulfills the College of Liberal Arts and Science's laboratory science requirement*.

Learning Goals of the Course

The learning goals of this course include:

- Analyze the extinction pressures acting on modern organisms into the context of those organisms' geologic, evolutionary, and climatic history.
- Construct an action plan for mitigating the current mass extinction event that is informed by their understanding of organisms' roles in and relationships with the Earth system.

In order to accomplish these higher-level goals, students needed to accomplish a wide range of lower level goals, from synthesizing findings of peer-reviewed literature to achieving ownership over their position in the earth system.

Description of the Learners

Our learners represented a wide range of majors, from film production to architecture to chemical engineering. Of the 48 students who completed our survey, 67 % self-identified as freshmen or sophomores, over half had never taken a geology course in grade school, and only four intended to major in geology.

Rationale for Flipping

Multiple faculty members had taught this course for decades as a traditional paleontology course. One of the case study authors, Olcott Marshall, had taught it this way four times prior to the redesign process. When Bitting, the other case study author,

was hired as a teaching fellow, we took the opportunity to redesign the course to produce engaged, empowered, scientifically literate citizens. It is increasingly clear that the modern biodiversity crisis, engendered by human-induced climate change, is the sixth mass extinction event in the history of our planet (e.g., Ceballos et al., 2015). Flipping the course allowed us to engage students in a dialogue about the meaning of these events in the context of the ancient and varied history of our planet, challenge them to analyze data about the planet's biological and climatic past and present themselves, and encourage students to connect their conclusions about the natural world to their everyday lives. Shifting basic content delivery before class freed up in-class time for students to practice application, analysis, synthesis, and evaluation with the support of their peers and the instruction team.

Model Used to Guide the Flipping

Throughout the redesign process, we used the learning goals as the primary guide to decision-making around assessments and activities for the course (c.f. "backwards design," Wiggins & McTighe, 2005). By doing this, we ensured that all of our work and the students' work throughout the semester was directed at moving their learning forward in a cohesive direction. With regular practice and feedback, meaningful assessment and reflection, and peer and instructor support, students developed deeper-level thinking skills that allowed them to complete the ambitious final project with outstanding results.

Structure and Implementation

Structure of the Flipped Course

The redesign shifted the balance from breadth to depth. The semester was divided into thirds, first focusing on paleontology concepts such as fossilization and deep time, the second using the Cretaceous period as a lens through which to examine evolution and extinction, and the third exploring modern biodiversity and climate in light of the prior concepts. The first two segments of the course culminated in individual take-home essay assignments, while the final segment and the course as a whole ended with a group research project.

Preparation of Learners for Participating in Flipped Instruction

From the start, we emphasized that this course would be different from a traditional lecture. On the first day, we asked students to brainstorm individually about how the course was relevant to their own lives and work in groups to determine the benefits of collaborative learning. Throughout the first few weeks, we revisited rationales

for self-directed learning, collaborative learning, and active learning, connecting them to student observations or work products, until very few students maintained a resistance to the flipped approach.

Description of In-Class and Out-of-Class Activities

We used reading circle worksheets as the basic pre-class preparation assignment, placing accountability for coming to class prepared primarily in the hands of the student's peers. The reading circles consisted of a series of assigned roles, rotated with each new reading assignment, that guided students through an aspect of dissecting or connecting to the text. For 10 min near the beginning of each class, student learning teams discussed the readings and the various perspectives developed through the worksheets. Then, the instructor led a five-min, whole-class discussion to help the students integrate those ideas and connect them to the day's activities.

Each day had a relatively consistent structure, which helped students (and the instruction team) feel comfortable with the departure from the usual lecture style. First, one student would present a "dinosaur of the day" to the class in about five min, based on research about the fossil record of that organism, evidence of its behavior and lifestyle, and how scientists interpreted that evidence. Next, students used iClickers (i.e., electronic student response system) to answer multiple-choice questions applying ideas from the previous class in new ways, and they would discuss any questions that were unclear (usually about 5–10 min). The reading circles process then moved the focus forward from prior lessons to the current topic. Finally, the class moved through a series of individual and team worksheets around the day's goals. These worksheets often started out with individuals activating prior knowledge, proceeded through more complex team activities such as analyzing representations of scientific data, forming and testing hypotheses, and finding reliable information about scientific ideas, and culminated in reflection and integration prompts. At various moments, often at the end of one worksheet and before beginning the next, we brought the student learning teams back together for a whole class discussion to help them make sense of their growing and changing knowledge and experience.

Tools Used to Support the Flipped Process and Learners

In addition to the iClickers, we use the CATME system (http://info.catme.org/) to assign permanent learning teams that included a diversity of students whose schedules had common blocks of out-of-class time free. After assigning the teams, we employed supports such as asking teams to write a contract to guide their interactions, and including a peer evaluation as a portion of the students' grades.

Differentiation of Instruction

The team structure of the course built in an automatic level of support for students with different strengths, prior experience, and abilities: By intentionally structuring teams to include students with a wide range of majors and years in school, we sought to maximize the resources each team would have at its disposal. Making teams permanent allowed team members to get to know and trust their peers enough to draw on one another for support.

Our instructional team provided another level of support for individuals and teams in the course. Two peer learning assistants (undergraduates who had successfully completed other introductory geology active-learning courses), one graduate teaching assistant, and both of us circulated during activities and team-level discussions, prompting students with questions to deepen their thinking and helping guide their learning.

Assessment of Student Learning

Prior to the redesign, the course consisted almost entirely of summative assessment. The redesigned model of the course included abundant formative assessment. Fifteen class assignments and reading circles worksheets each were graded from each student for low-stakes points, and we concentrated on providing more written feedback near the beginning of the semester. However, the more effective type of formative feedback often came in the form of class-level discussions and debriefs on each activity, as well as conversations about common mistakes or problems the instruction team noticed in the various graded items and (sometimes student-generated) ways to tackle them.

Summative assessment also changed form, moving away from multiple-choice exams that emphasized lower-level knowledge and understanding. The ends of the first two units of the course were punctuated by take home essay assignments that asked students to individually practice higher-level thinking skills they had been developing in class as a team. The semester as a whole culminated in a public, collaborative, science-fair style project, in which each team researched an ancient, extinct organism and a related modern, endangered organism, and connecting the ideas they learned about the past to craft a plan to further conservation efforts for the modern animal. The instructional team graded team projects using a rubric, and students evaluated other teams based on the rubric as well.

Lessons Learned

The Instructional Experience

Our experience in teaching this course left us deeply impressed with the learning and work ethic our students brought to the experience. In many cases, we observed students who were not geology majors thinking and working on levels often

expected of beginning graduate students in our discipline! Instructors and deans from across the university attended our class' final project, and were so impressed with the depth and quality of student learning that at least five other courses have adopted this final exam alternative.

The Student Experience

Based on their comments during the final project presentations, the students clearly recognized the value of the flipped learning experience was far above and beyond what they usually got out of a lecture format. As just one excellent example, one student commented, "It's very cool to get to talk with someone every day and get to know people on a different level than you would anywhere else … You actually have to think more about [the course content] because there's a question in class every day about what you've learned. You have to discuss it with three other people. In lecture you might think you don't even have to read the book. You actually have to know what you're doing when you come to class."

A Case Study on Physics

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Instructional Context

Course Name and Description

General Physics I is the first of a two-part introductory algebra/trigonometry-based physics course designed primarily for non-science majors. Using an inquiry-based, integrated laboratory-lecture approach, the course is taught in a flipped learning environment using active peer learning. Topics covered include motion, energy, momentum, rotational motion, force, simple harmonic motion, and wave motion. The course uses a variety of open educational resource (OER) materials based around OpenStax College's *College Physics*.

Place of Course in Larger Program of Study

This four-credit course satisfies the general education science laboratory requirement for all Associate of Arts (A.A.) degree-seeking students and is required for students in certain majors (construction management, electronics engineering, physical therapy, and pre-med biology).

Learning Goals of the Course

- Effectively communicate qualitative and quantitative information orally and in writing.
- Explain the application of fundamental physics principles to various physical phenomena.
- Apply appropriate problem-solving techniques using graphical, mathematical, and written modeling tools.
- Work effectively in collaborative groups.

Description of the Learners

The majority of the learners are traditional college students (18–22 years old), all are nonresidential, many are single parents, 90 % are majoring in some aspect of allied health field, and all have had at least College Algebra.

Rationale for Flipping

Historically, the students in this class have struggled applying concepts when doing homework. Often, they would simply give up without completing much. After learning about flipping at a national conference, I decided to try it. I told my students of my plans to start flipping my classes in the upcoming year and they begged me not to wait. So, I started immediately and never looked back.

Models and Theories Used to Guide the Flipping

While many instructional models such as just-in-time learning, personalized learning, and active engagement have directly or indirectly influenced the design of this class, one model has been seminal. Using discovery learning (Bruner, 1971) as the basis, assignments are structured to provide the preliminary knowledge necessary to complete tasks prior to class and then during class, students generate ideas, test solutions, and explain results individually and in groups.

Structure and Implementation

Structure of the Flipped Course

The class is divided into two-week topical modules, each containing one or two textbook chapters, homework assignments, lab activities, and an exam. Homework is intended to be completed during class, typically in small groups. An integrated laboratory further provides each group with hands-on exploration and discovery experiences. Each module concludes with an exam. The semester ends with a cumulative final and a team-based research paper and poster.

Preparation of Learners for Participating in Flipped Instruction

On the first day of class, I explain the characteristics of a flipped classroom and my expectations. I also present students with comparative student performance data showing significant improvements in grades and student satisfaction since adopting the flipped model. I also show video testimonies from previous students.

Description of In-Class and Out-of-Class Activities

In-class. I start each in-class session with a scaffolded, collaborative, small-group activity. This may be a short video, incorrectly solved problem, or a ranking task-type question. As an example, when studying fluid viscosity, I have them view a YouTube video and take measurements from the video to solve for actual quantities. Ideally, this activity is also intended to build confidence for problem solving. Before flipping my classroom, this type of problem solving usually occurred as homework and was where most students struggled. In the flipped classroom, students indicate they have the support they need from both their peers and instructor when completing homework assignments. By observing and interacting with them and their groups, an added benefit is that I am better able to understand where they are struggling.

Out-of-class. In an effort to extend the learning well beyond the classroom, I have a series of assignments that students must complete prior to the next class. This includes both pre-class and post-class assignments.

To engage students and encourage them to think about the assigned topic prior to class, a virtual polling question or asynchronous collaborative discussion-board activity is assigned for students to make predictions, test ideas, and formulate potential responses to a posed question. For instance, on the topic of electric circuits, I ask them to predict and justify which light bulb in a complex series–parallel circuit would be brighter when connected to a battery. All content for each topic is provided in the form of an online OER textbook along with self-created, supporting videos, and screencast PowerPoint recordings. Students are also given four or five

questions about key topics using the Cornell Note format, a focused note-taking methodology which by design gets students to not only take notes, but then to reflect on them and identify key points, and then to write a concise summarize of their notes. I collect these at the start of each class and quickly scan, grade, and return them for use when completing their in-class work.

To help students build confidence and understanding of what was covered in class, I typically assign an additional problem or challenge for students to complete on their own after class. This gives them the opportunity to test their own understanding of the material. For instance, I might select a more advanced end-of-chapter problem that integrates multiple concepts. Finally, I require students to post to an online, reflective discussion board where they answer one key question from that day's material and then I then ask them to identify anything that is still unclear. Students are expected to also respond to at least one other posting and, almost without exception, one or more of them will provide an explanation to something another student listed as being unclear. If not, I simply address any misunderstandings at the start of the next class.

Tools Used to Support the Flipped Process and Learners

To create interactive learning materials, I make screencastings of my lecture PowerPoints and include embedded questions. Providing content in this manner is useful to many students as it allows them the ability to stop and rewind the videos as desired. I also use virtual polling tools to add variety. I've discovered that by consistently using one or only a few tools such as a blog or discussion board, students often start perceiving activities as rote or routine. By changing up tools, students find the variety more engaging and seem excited to see what "new" things are in store for them each class period. Varying the way students interact with the material adds an element of novelty that should be considered when designing a flipped class.

Differentiation of Instruction

The flipped classroom is ideally setup to provide differentiated learning. Students who need more time to absorb lecture material can simple pause and rewind the screencasted PowerPoints until they understand the concepts. To accommodate different preferences to receive content, material is available online from a variety of sources in different formats; textbook, PowerPoints, screencasted PowerPoints, links to various YouTube videos and to online physics simulations. During class, students can work at their own pace. Most will be doing the lesson for the day, some will be catching up on last week's assignments, and a few will ask for supplemental problems.

Assessment and Student Learning

Although most assessments in this class are traditional, one assessment strategy unique to the flipped version of this class is my review of the students' Cornell Notes associated with every reading assignment. Students submit their notes using the Cornell Notes format upon entering the classroom. I quickly scan and grade them for understanding and return them. This is a simple method to help students be better prepared and to allows me to identify any individual or collective problems with their understanding of the material.

Lessons Learned

The Instructional Experience

Adopting the flipped learning method has completely changed the dynamics of my classroom. No longer am I the sole "fountain of knowledge" in the class with students simply taking notes, answering my questions, and occasionally asking questions. Now, I am the "class facilitator," continuously roaming the classroom providing just-in-time instruction to clarify issues and answering individual questions. During a typical 75-min class, I talk with each of my 24 students at least three times. My students are actively engaged with one another exploring and applying new concepts and continuously shifting around the class seeking help from others. This might appear quite chaotic, students are experiencing a much deeper level of learning that is highly individualized.

The Student Experience

For students, the flipped classroom is a very different experience. Now, they are required and held accountable for reading the textbook and taking notes *before* class. No longer can they just come to class expecting to be told everything they need to know. Instead, the responsibility for learning has been shifted to their shoulders. Once students get accustomed, they usually love the experience as they can study at their own pace. In the class, they are challenged to be actively engaged and to complete their homework. Knowing that their classmates and the instructor will help them gives them confidence to tackle any homework assignment. Overall, I know my students are learning the material better as the class average, using the same exams as I did when not flipped, has raised three-quarters of a letter grade. When surveyed, 92 % of my students say that, if given the option, they would select a flipped class over a traditional one.

References

Ben-Ari, M. (2001). Constructivism in computer science education. *Journal of Computers in Mathematics and Science Teaching, 20*(1), 45–73.

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Washington, DC: International Society for Technology in Education.

Bruner, J. (1971). The process of education revisited. *The Phi Delta Kappan,* 53(1), 18–21. Social *foundations of thought and action: A social cognitive theory*. New York: Prentice Hall. Retrieved from http://www.jstor.org/stable/20373062

Ceballos, G., Ehrlich, P. R., Barnosky, A. D., Garcia, A., Pringle, R. M., & Palmer, T. M. (2015). Accelerated modern human-induced species losses: Entering the sixth mass extinction. *Science Advances, 1*(5), e1400253.

Cennamo, K., & Brandt, C. (2012). The 'right kind of telling': Knowledge building in the academic design studio. *Educational Technology Research and Development, 60*(5), 839–858.

Goodwin, B., & Miller, K. (2013). Evidence on flipped classrooms is still coming in. *Educational Leadership, 70*(6), 78–80.

Jonassen, D., & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational Technology Research and Development, 47*(1), 61–79.

Kay, J., Barg, M., Fekete, A., Greening, T., Hollands, O., Kingston, J. H., & Crawford, K. (2000). Problem-based learning for foundation computer science courses. *Computer Science Education, 10*(2), 109–128. doi:10.1076/0899-3408(200008)10:2;1-C;FT109

Machanick, P. (2007). A social construction approach to computer science education. *Computer Science Education, 17*(1), 1–20. doi:10.1080/08993400600971067.

McDowell, C., Werner, L., Bullock, H. E., & Fernald, J. (2006). Pair programming improves student retention, confidence, and program quality. *Communications of the ACM, 49*(8), 90–95. http://doi.acm.org/10.1145/1145287.1145293.

O'Grady. M. J. (2012). Practical problem-based learning in computing education. *ACM Transactions on Computing Education*, *12*(3), article 10. doi:10.1145/2275597.2275599

Porter, L., Guzdial, M., McDowell, C., & Simon, B. (2013). Success in introductory programming: What works? *Communications of the ACM, 56*(8), 34–36. http://doi.acm.org/10.1145/2492007.2492020.

Savery, J. (2015). Overview of problem-based learning: Definitions and distinctions. In A. Walker, H. Leary, C. E. Hmelo-Silver, & P. A. Ertmer (Eds.), *Essential readings in problem-based learning* (pp. 5–15). West Lafayette, IN: Purdue University Press.

Shore, J., & Warden, S. (2007). *The art of agile development*. Sebastopol, CA: O'Reilly Media, Inc.

Simon, B., & Hanks, B. (2008). First-year students' impressions of pair programming in CS1. *Journal on Educational Resources in Computing, 7*(4), 28 pages. http://doi.acm.org/10.1145/1316450.1316455.

Vaughan, M. (2014). Flipping the learning: An investigation into the use of the flipped classroom model in an introductory teaching course. *Educational Research & Perspectives, 41*(1), 25–41.

Wiggins, G. P., & McTighe, J. (2005). *Understanding by design*. Upper Saddle, NJ: Pearson Education.

Flipping Health Sciences

A Case Study on Medical Laboratory Science

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Instructional Context

Course Name and Description

Clinical Chemistry and Instrumentation is a senior-level course in the Idaho State University (ISU) Medical Laboratory Science (MLS) program. The aim of the MLS program is to provide required theoretical and practical knowledge for the MLS professional. *Clinical Chemistry and Instrumentation* involves theoretical and applied aspects of clinical chemistry and emphasizes development, validation, and diagnostic use of lab tests.

Place of Course in Larger Program of Study

Upon acceptance into the MLS program, students begin with *Clinical Chemistry and Instrumentation* as one of their first courses. Students complete the MLS program through two semesters of didactic lectures and corresponding labs followed by 12 weeks of clinical rotations. Upon completion, students are eligible to take the national board exam.

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Learning Goals of the Course

Clinical Chemistry and Instrumentation supplies fundamental knowledge and understanding of chemistry lab test principles and results. Goals for the course include understanding:

- underlying lab test principles
- safety considerations
- test limitations
- test procedures
- clinical significance
- problems with test orders, specimen collection, and specimen preservation
- equipment calibration issues
- determining the validity of and reporting the results.

Description of the Learners

MLS students are primarily older, non-traditional students. Many of these students do not live on campus and consequently must travel to one of three campus locations or participate online. Additionally, 15 % speak English as a second language, 60 % are parents or guardians, and 70 % work.

Rationale for Flipping

In addition to flipping the labs to meet the increasingly non-traditional and rural population needs, we found that a significant amount of lab time was spent lecturing or waiting for tests to run. Furthermore, maintaining labs in three physical locations incurs substantial costs for obtaining and maintaining equipment, supplies and lab space, procuring specimens, setup and tear down time, hazardous waste disposal, travel, and staffing personnel in each location. There was also the added responsibility of providing online students with a comparable lab experience, which includes more than merely the step-by-step ("hands-on") lab procedures. Therefore, it was determined that flipping the labs would provide a more student-centered approach that used time and student fees more efficiently and could provide students with the abilities to apply, analyze, evaluate, and synthesize the content.

We have taught this course since fall 2009 and started flipping the labs at that time. We added one or two labs, depending on their complexity, each fall semester since. At present, we have created and implemented 11 different clinical lab activities. During the flipping process, traditional face-to-face labs were also held on campus.

Models and Theories Used to Guide the Flipping

The flipped labs were developed using elements of Allen's (2003) context, challenge, activity, and feedback (CCAF) matrix and Merrill's (2002) First Principles of Instruction (activation, demonstration, application, task/problem-centered, and integration). Clinical lab tests are simulated using online reusable learning objects (RLOs), which delivered alone would be e_3-learning (e sub 3 learning) according to Merrill (2008, 2009). To create Merrill's e^3-learning (e to the third power learning), the RLOs were contextualized into scenario-based, authentic learning activities using the "Lesson" activity housed within the university's learning management system (LMS), Moodle.

Structure and Implementation

Structure of the Flipped Course

The course lectures are broadcast to three campus locations synchronously for 50-min three days per week during 16-week fall semesters and are simultaneously recorded for asynchronous online delivery to distance students. The lectures provide required background knowledge for performing the labs. The course begins with an introduction using the course syllabus, objectives, and expectations. The course progresses from pre-analytic considerations through the analyses of different body systems, post-analytic troubleshooting, and reporting results.

The flipped labs are dispersed throughout the semester with students completing approximately one flipped lab online each week. During the labs, students interpret two quality control samples and a minimum of five patient samples. A final end-of-semester flipped lab recreates the real-life lab atmosphere by requiring students to consider multiple tests simultaneously. The flipped labs prepare students ahead of time for their clinical rotations without using class time or generating additional lab costs.

Preparation of Learners for Participating in Flipped Instruction

Students read standard operating procedures (SOPs) for labs prior to lectures. This allows class discussions to focus on clinical significance, procedural steps, required supplies, reference ranges, interpretations, and possible limitations. Students also participate in lab demonstrations during lectures to familiarize them with the procedures and cognitive processes required to complete the labs. We encourage students to think like medical lab scientists and help them build self-regulated study habits by having them perform the lab exercises individually.

Description of In-Class and Out-of-Class Activities

During class, students participate in discussions and attend to didactic lecture material, which may be supplemented with guest speakers from the professional field. Students also discuss case studies as a class or in small groups. The online students participate in case studies by posting their responses in discussion forums before viewing recorded class discussions. Outside of class, all students are instructed to read their textbooks, SOPs, and supplemental resources. Students also complete the flipped labs outside of class.

Tools Used to Support the Flipped Process and Learners

The labs were flipped using Flash-based RLOs delivered using Moodle Lessons, which supports embedding RLOs in questions and delivering immediate feedback as questions are answered. RLOs were created in Flash using digital images of clinical site equipment and test results. Students must use a Flash-enabled Web browser to complete the flipped labs.

Differentiation of Instruction

Moodle Lessons provide individualized, self-paced instruction. Students do not have to wait for others to catch up or feel as though they are holding up the group, thereby eliminating the stress some students may feel in face-to-face lab settings. Students may also fear making mistakes in face-to-face labs. Lessons provide a safe environment because each student's performance is private. Lessons also provide specific feedback, based on student answers, that addresses misconceptions. All students can review the recordings of the in-person lectures and lab demonstrations. After deadlines, non-graded versions of Lessons are available for student practice and review. Depending on their preferences, students can read printed or electronic versions of SOPs.

Assessment of Student Learning

Prior to flipping the labs, students' clinical skills were primarily assessed based on attendance and participation. Students were generally assessed as a group due to limited individual performance measures. Since flipping the labs, students' lab skills have been evaluated using their individual online lab performance provided through Moodle Lesson analytics. Overall problem areas for individual students and the whole class can be evaluated using these analytics.

Certification exam performance, certification exam pass rates, graduation rates, and employment rates have shown no significant differences between students who completed *Clinical Chemistry and Instrumentation* prior to or after flipping the labs. Since flipping the labs, we have also found consistent employer satisfaction

with graduates after placing them in the workforce. Additionally, student responses on course evaluations have shown enthusiastic support for the flipped labs.

Lessons Learned

The Instructional Experience

Throughout the process of flipping these clinical labs, we noted a strong need for support from the university/department. The necessary resources to flip these labs would not have been available without that support. It is also essential to employ someone who knows programs such as Flash and other video/image editing software in addition to the LMS. Without this skilled individual, it would not have been possible to create the RLOs and integrate them in the Moodle Lessons. Furthermore, "reverse-engineering" the labs is time-consuming and faculty must be available for collaboration and able to invest the additional time needed up front.

We would also stress the importance of providing instructional interactivity (cognitive engagement), which we consider "heads-on" learning. It is one thing to create an RLO and quite another to ensure students are actively thinking about the underlying concepts. Mindlessly clicking through an online exercise has little or no educational value.

In the future, we look toward building variation into test results as well as opportunities for troubleshooting simulated equipment malfunctions. We would also like to explore the Lesson's branching capabilities for adaptive learning. Branching could increase personalized feedback by providing more specific remediation.

The Student Experience

Students have commended the efficiency of the flipped labs because of the shortened times required to run lab tests, which affords the opportunity to run multiple tests. Students also appreciate the lack of distractions and interruptions typically associated with in-person labs. Furthermore, students have voiced gratitude for the exposure to infrequent occurrences they may not otherwise have seen. One student stated, "I found the interactive online labs to be a very effective way to teach. I learned more in the online labs than I did in any other learning environment I had experienced and they prepared me very well to practice in the medical lab field."

A Case Study on Nursing

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Instructional Context

Course Name and Description

Nursing Fundamentals is a foundational course for all nursing programs that introduces students to the underpinnings of clinical nursing practice.

Place of Course in Larger Program of Study

This is an introductory course serving as a prerequisite for all future undergraduate nursing clinical courses.

Learning Goals of the Course

My objectives comprised the basic competencies required of a professional nursing graduate. At the completion of the didactic course, students should be able to:

- apply fundamental principles to promote, maintain, and restore patient health and well-being.
- utilize the nursing process, critical thinking, and therapeutic communication skills.
- demonstrate professional behaviors to ensure patient safety and delivery of quality care.

Description of the Learners

The learners enrolled are newly admitted undergraduate nursing students.

Rationale for Flipping

I have offered *Nursing Fundamentals* for several years as a traditional lecture-based instruction course. Student attendance was poor, engagement was limited, and satisfaction was low. I chose to flip the classroom instruction to shift the learning dynamic to an environment of active learning.

Model (s) and Theory (ies) Used to Guide the Flipping

I applied team-based learning (TBL) pedagogy to structure a new course. TBL is a flipped instruction method that incorporates learning activities with specific processes for assessment of student progress toward learning outcomes. There are three stages of the TBL design: individual preparation assignments; learning assurance assessments; and team application activities (Michaelen, Parmelee, McMahon, & Levine, 2008).

The first stage of TBL involves flipped instruction, and begins with faculty assigning individual preparation for students. The individual preparation assignments are completed out-of-class prior to scheduled in-class time. In the second stage, in-class learning assurance assessments are assessed and a "mini-lecture" is delivered. Results of the in-class learning assurance assessments are used to focus this mini-lecture, reviewing only a portion of course content for the instructional unit, as opposed to delivering a comprehensive lecture. The third stage of the TBL sequence involves in-class team application of course concepts. In this stage, team application activities account for most of the in-class time allotted for the course. All three stages of TBL require students prepare for class and engage as active participants in learning, offering both academic and social rewards.

Structure and Implementation

Structure of the Flipped Course

I implemented the flipped instruction, using TBL design, in a 10-week *Nursing Fundamentals* course. Classes met for three hours per week. I divided the course into seven major instructional units. The three stages of TBL design were applied to each of the seven instructional units. For each unit I developed specific individual preparation assignments, learning assurance assessments, and team application activities.

Preparation of Learners for Participating in Flipped Instruction

To prepare students for TBL I delivered the course overview session as a TBL instructional unit. The unit content included the course syllabus. Stage One individual preparation required students review the syllabus out-of-class, prior to the first day. Stage Two began in class with students receiving a 15-item individual learning assurance assessment quiz based on syllabus content. I then formed student teams in a transparent manner by dividing the 80-student cohort into 12 teams. Students were assigned to teams based on formal healthcare experience, with teams comprised of members ranging from those with high levels of healthcare experience to those with minimal or no healthcare experience. I then proceeded by providing the same 15-item quiz to each newly formed team. I completed Stage Two with my in-class 'mini-lecture' focused on strategically reviewing the syllabus. For Stage Three students completed an in-class application activity that required them to assign percentages of final course grades to TBL activities. Students completed this activity on large poster paper that was posted on the walls around the lecture hall. A gallery walk followed with teams circulating and reviewing all posters. Each team was permitted one vote for the poster that best represented a fair course grading rubric. This process allowed students to experience TBL, and it was widely received with positive student feedback.

Description of In-Class and Out-of-Class Activities

The remaining flipped classes each included an out-of-class activity that required students to prepare, on their own, for the next instructional unit. Individual preparation assignments included required textbook readings, current evidence based-practice articles and resources such as clinical vignettes, voiced over PowerPoint documents and standardized video demonstrations of procedures and techniques. The individual preparation assignments were provided one week prior to each of the instructional units.

In-class activities were conducted for each of the seven units starting with the learning assurance assessments. The learning assurance assessments were 15-item quizzes that required application, evaluation, and synthesis of course concepts. Students took the same learning assurance assessments as individuals and again in their assigned teams at the beginning of class, each counted toward course overall grades. Learning assurance assessments took 40 min of in-class time and required application of concepts not simply recall of facts.

In-class activities continued with a mini-lecture. Following a brief review of the learning assurance assessment data I adapted these lectures in real-time, omitting materials and reinforcing concepts accordingly. Thirty to 40 min of in-class time was reserved for these lectures.

The remainder of the unit's in-class time was spent on the team application activities for each of the seven units. These in-class application activities were case studies developed to reflect specific unit's learning objectives. Sixty to 90 min of in-class time was reserved for the team application activity.

Tools Used to Support the Flipped Process and Learners

The flipped process of TBL required use of technologies for out-of-class and in-class activities. Many institutions of higher education have on-line learning management systems available, as was the case at my institution. I used this platform to deliver all out-of-class information to students including announcements, resources, and individual preparation assignment materials. I uploaded PowerPoint documents with voice over, graphic organizers, videos, and added links. I used the quiz feature on the learning management system to deliver individual learning assurance assessments in-class. This provided me with immediate results and the ability to rapidly analyze responses. I used the discussion board feature on the learning management system to post team learning assurance assessment quiz scores and images of all teams' final posters for each module's team application activity.

I also included non-technological tools for *Nursing Fundamentals*. To provide immediate feedback on team learning assurance assessment quizzes I used scratch-off cards that were keyed to reveal the correct answers. Self-adhesive poster paper was used to display team application activities in the lecture halls.

Differentiation of Instruction

Differentiation of instruction through use of TBL flipped design provided for all student learning styles and abilities accommodating for visual, aural, rote, and kinesthetic sensory modalities of learning. Assignments included materials to support every learner preference. For example I included graphic organizers, videos/podcasts/presentations, readings, and research activities for each module.

Assessment of Student Learning

I was able to conduct both summative and formative assessments of student learning in the flipped instruction TBL *Nursing Fundamentals* course. In the past, only summative assessments were available in the form of mid-term and final examinations. Offering flipped instruction TBL design *Nursing Fundamentals* allowed me to additionally monitor student learning with formative evaluations, learning assurance assessments and application activities. Inclusion of these formative assessments helped the students to identify strengths and weakness as well as helping me to address areas of student struggles.

Lessons Learned

The Instructional Experience

Flipping instruction for *Nursing Fundamentals* was a two-step process. First I had to adapt the course to TBL design and then I needed to develop curriculum to follow the three stages of the TBL design.

Developing TBL curriculum was challenging. TBL is an extremely prescribed teaching and learning strategy which requires all stages to be instituted. There are many TBL resources available that include recommendations for implementation. I used these resources to adapt a TBL course checklist and faculty facilitation checklist that I then used to ensure TBL fidelity.

I also learned lessons specific to the three stages of TBL. Individual preparation assignments required much effort and time to develop. To ensure differentiation of instruction, I created assignments that would appeal to all learner types and preferences. This required much research as well construction of videos, scenarios, and clinical vignettes. I formulated learning assurance assessment quizzes that tested critical thinking not simple recall of facts. Writing these types of multiple choice questions requires significant effort and review. I strongly recommend a quizzing system with automatic grading, which allows for real-time paring down lectures to the mini-lecture. Lastly, application activities are easily developed by matching activity outcomes to course objectives.

The Student Experience

My personal observations of flipped instruction TBL in-class consisted of an engaged student cohort conversing, laughing, and most importantly learning. Students worked in diverse teams, not of their own choice, and achieved significant successes. It was a phenomenal experience, and this was consistent with every unit.

There is some concern in the published literature regarding student satisfaction and student perception with flipped instruction and TBL. Specifically, students have reported lower levels of satisfaction when required to be active learners (Jafari, 2014). I did not observe this, nor did my course evaluations reflect any negativity toward flipped instruction. Many students' comments on final course evaluations included requests for more of their courses to be taught using this engaging strategy.

A Case Study on Flipping in a Pharmacy Therapeutics Course

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Instructional Context

Course Name and Description

Integrated Pharmacotherapy (IPT) I: Electrolytes, Acid–base, Anemias and Kidney Disease is a required two-semester credit hour course offered at Texas A&M Rangel College of Pharmacy (RCOP). Historically, the average class size was 85 students; however, this will expand to 120 in Fall 2015. The team is taught collaboratively by five instructors.

Place of Course in Larger Program of Study

IPT I is the first in a sequence of eight team-taught IPT courses. The series is integrated across medicinal chemistry, pathophysiology, pharmacology, and pharmacotherapy disciplines and taught in topic modules.

Learning Goals of the Course

A major learning goal of this course is for students to develop a pharmaceutical management plan for patients with renal diseases, acid–base disorders, fluid and electrolyte abnormalities, and anemia.

Description of the Learners

The learners are second year doctorate of pharmacy (Pharm.D.) professional students. The Pharm.D. curriculum is four years long, of which the first three years are mostly didactic learning combined with service and experiential learning. The fourth year is entirely experiential and consists of six required six-week rotations.

Rationale for Flipping

Prior to the flip in Fall 2012, this course was delivered in a traditional lecture format for five years. During this time, several issues were identified in the learning environment. First, despite the frequent use of an audience response system, TurningPoint®, few students were engaged in the large lecture setting. This problem was exacerbated when lectures were delivered over the videoconferencing system by distance faculty. While a separate, weekly pharmacotherapy lab course provided the opportunity to apply content knowledge to simulated patient cases, we noted that students had difficulty with this task. Our two primary goals were: (1) to improve the learning outcomes by engaging students through active learning and (2) to develop critical thinking skills needed for contemporary interdisciplinary health care.

Model (s) and Theory (ies) Used to Guide the Flipping

We reviewed a variety of educational literature to guide the redesign of this course, including active, blended, and inverted learning, flipped classroom, the Quality Matters™ rubric, and peer-to-peer instruction (Blouin et al., 2009; Crouch, 2009; Lage, Platt, & Treglia, 2000; Day & Foley, 2006). We also consulted the literature on student attention span and microlectures, and reviewed online videos available at the Khan Academy and Udacity.

Structure and Implementation

Structure of the Flipped Course

This two credit-hour course is completed during the first five weeks of the fall semester. The 30 contact hours are separated into either online microlectures or face-to-face time as determined by each instructor.

Preparation of Learners for Participating in Flipped Instruction

Prior to beginning the course, we asked students to view a recorded microlecture in which the learning activities, student responsibilities, rationale, and goals of the flipped classroom were explained. After viewing, students submitted their answers

to the following—"what questions do you have for the course coordinators?" During the first class, which was held face-to-face (F2F), we oriented students to the structure of the flipped classroom and their responsibilities in the new learning environment, contrasting it with the traditional classroom. We asked them to arrange themselves in small groups of four to six students with whom they felt comfortable working. We told them that during in-class sessions, they would be given clinical case situations that required applying the learning gained from the microlectures, and that we would permit them to work out solutions together. We ended the first class with a question-and-answer session using the questions they submitted through Blackboard.

Description of In-Class and Out-of-Class Activities

The online environment included the prerecorded video lectures—microlectures. We decided to limit the material to one or two learning objectives for each microlecture and aimed for six to ten min per video to focus student attention towards major concepts. Self-assessment questions were embedded in the microlectures and practice problems were made in Blackboard for additional practice after the F2F session.

At the end of the microlectures and prior to each F2F session, we asked students to submit their "muddiest points"—concepts that required further explanation during the F2F interaction.

During a typical F2F session, three activities occurred. First, each new topic began with an individual readiness quiz (typical length 15 min) to increase student accountability for viewing the microlectures. Next, we provided a focused discussion of some of the "muddiest points" submitted by the students. The remaining class period was spent on case-based group discussions where students were presented a short clinical scenario followed by several TurningPoint® audience response questions that required students to apply concepts from their microlectures.

Tools Used to Support the Flipped Process and Learners

We recorded the microlectures and embedded questions by narrating our PowerPoint slides using Camtasia Studio and a webcam. We intentionally included our talking heads rather than just the voice in our efforts to hold the students' attention. Recordings were saved to a network storage location reserved for this course from which the college's instructional technologist retrieved the recordings, edited them, and posted the finalized files in Blackboard. During the first two years, the individual readiness quiz was administered as a paper assessment using Scantron® scoresheets, thereafter; we administered these assessments on the students' laptops using ExamSoft®. To capture student responses during in-class clinical case discussions, we used TurningPoint® (Turning Technologies). All in-class sessions were recorded and made available on Blackboard as streaming video.

Differentiation of Instruction

During the course, no differentiation of instruction was done.

Assessment of Student Learning

Prior to the flip, student learning was assessed predominantly through multiple choice exams and homework assignments. After the flip, exams included more open-ended questions, the number of assignments increased to include the case-based questions from the F2F sessions, and the individual readiness quizzes were added.

Lessons Learned

The Instructional Experience

Start early. Due to the large increase in preparation time required when flipping a course, we realized the importance of planning at least a year in advance when more than a few lectures are going to be flipped.

Build in accountability for student completion of outside class experiences. Our in-class quizzes were time-consuming, but vital to ensure students were viewing the microlectures and working through the practice problems. Accountability for the out-of-class experiences is vital to student success in the F2F environment.

Evaluate and adjust student expectations of the learning environment. Many of our students' previous classroom experiences were dominated by the traditional lecture style. Students initially complained about excessive time spent viewing microlectures and preparing for the flipped classroom approach, despite our introductory efforts to prepare them for the change. Our future plans will be to integrate more metacognitive strategies during orientation to get students thinking about what their expectations of the classroom are and then illustrate how the flipped classroom can potentially enhance the classroom environment and their learning.

The Student Experience

One of the major themes that evolved from our observations of the student experience is that they need a lot of assistance upfront regarding how to be successful in a learning environment where it is necessary for them to exhibit high levels of self-regulation (Zimmerman, 1990). Students appreciated the flexibility and convenience of the recorded microlectures, but they did take a disproportionate amount of time to view these videos due to a large increase in note-taking time compared to the traditional lecture format. From what we can gather, their strategy for studying from

the microlectures was, in essence, to prepare a transcript of the microlectures and read the transcript, which was a very time consuming process. In addition, many students struggled with managing their time between watching the microlectures, preparing for the readiness quiz, and completing work for their other courses. As a result, course orientations have included flipping the students' expectations of the traditional learning environment and setting realistic expectations about the preparation time required prior to the F2F interactions.

Our two main goals with flipping the course were to engage students through active learning and develop their critical thinking skills. We feel that our students are enthusiastic about our flipped course as evidenced by our receipt of the "Teaching Team Award" each year since we started flipping. Although we have not yet proven an impact on their critical thinking skills, we uncovered a wealth of information about how our students approach their learning and how the flipped classroom may evolve their ability to self-regulate their learning. Developing the skills needed to be a life-long learner may be an unexpected outcome of this instructional design.

A Case Study on Physical Education/Kinesiology

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Instructional Context

Course Name and Description

This *Muscular Strength, Flexibility, and Cardiorespiratory Fitness Physical Education* course was offered as a conceptual physical education and activity (PEA) course in kinesiology. The course was offered three days per week for 50 min. The students were taught skill acquisition and development of a personal exercise plan along with content knowledge about anatomy, physiology, and biomechanics of exercises and its respective importance to maintaining a healthy and active lifestyle.

Place of Course in Larger Program of Study

This course was an elective and students from all programs of study were welcome to enroll. Students across the various disciples enroll in these courses to attain specific health and fitness goals and to learn how to live a healthy and active lifestyle.

Learning Goals of the Course

The course provided students with opportunities to attain knowledge about the importance of being physically active and its requirement for maintaining a healthy and active lifestyle. The goals of the course included the following:

- To demonstrate correct operation of exercise machines and free weights.
- To explain concepts and benefits of resistance training.
- To develop a circuit training routine.

Description of the Learners

The learners were 56 male and female college students between ages 19 and 40 years. The students' academic programs were vast and included education, science, mathematics, engineering, and business.

Rationale for Flipping

Two major issues in the traditional course guided us to flip the class. First, the conceptual PEA course included a great amount of content, so students often did not have enough time for physical activity (PA) during a 50-min class. Second, due to the lack of class time, there were not enough lesson variations, which led to students' dissatisfaction with their physical education (PE) experience. Hence, we implemented the flipped approach for the first time in the kinesiology PEA course to enhance time to complete activities and help students be engaged in various lessons during a class in order to meet national guideline and requirement for PA.

Model (s) and Theory (ies) Used to Guide the Flipping

The experiential learning model (Kolb, 1984) and social cognitive theory (Bandura, 1986) were used to develop exploratory in-class activities and collaborative projects. Additionally, we studied several scholarly research studies (e.g., Lents & Cifuentes, 2009) conducted in the science fields and examined pros/cons of flipped classrooms, specific class activities, and course recommendations. Then, we incorporated suggested ideas (e.g., reducing the number of class meetings) into our course design.

Structure and Implementation

Structure of the Flipped Course

The flipped course consisted of 13 major muscles exercises (e.g., squat, dead lift, bench press, and calf raises) presented over the course of 12 weeks. Students were required to review instructional videos about the correct technique and anatomy

involved in performing the 13 exercise skills as well as a health and fitness knowledge PowerPoint voiceover before the class. Students were also asked to complete 10 short lectures health and fitness knowledge quizzes and 13 exercise skills quizzes after they reviewed the online videos/PowerPoint voiceover. The online materials were presented to the students in alignment with their class activities and students weekly goals. For instance, if the class activity included exercises like squats and push-up, then the course content addressed muscular strength and the benefits of those exercises. While the traditional course met three times per week, we reduced flipped class meetings to two times per week to assist students in reviewing instructional videos and completing quizzes at home and to promote outside PA. To facilitate outside activities, all students were required to prepare their individualized exercise program and to turn in an exercise log sheet of what they had done for the day when the class did not meet.

Preparation of Learners for Participating in Flipped Instruction

In the beginning of the course, students were taught about the structure of the flipped lessons, its benefits, and the importance of having autonomy and control over their learning. Emphasis was given on managing time and being aware of course responsibilities. Since these PEA courses were taught as electives and most students had specific exercise and health goals upon enrollment, the goals exhibited their willingness to monitor and regulate their actions to accomplish their set goals. Engagement in peer and group activities were also initiated at the beginning of this course.

Description of In-Class and Out-of-Class Activities

During the unit, in-class activities consisted of muscular strength and conditioning workout routines. A variety of exercises were incorporated into the class PA time to encourage group work and collaboration among students, including Wheelbarrow, Farmers' Carry, a Deck of Cards, and Circuit Championship. Students were often placed in groups of three to five to complete these activities. Throughout the course, the instructor and students were also engaged in discussions prior to exercising and at the end of class session. The discussions were informal and were centered on questions or concerns the students had pertaining to their weekly goals or PA and health. Out-of-class activities entailed reviewing instructional videos and completing quizzes to accompany the PA done in class. Students were also encouraged to write their own personal exercise program, using a log sheet, based on their weekly exercise and health goals. At the beginning of each week, students were required to turn in the log sheet that contained the length of time spent doing the exercise, intensity, type of exercise, and the goals that they had for the week.

Tools Used to Support the Flipped Process and Learners

Tools utilized in the flipped to support the instruction and students learning included a wiki, student's personal technology (e.g., iPhones, iPads, and laptops), PowerPoint, and online resources from YouTube, Google Scholar, TED Talks, health and fitness knowledge textbooks such as *FitSmart* and *Fit and Well.*

Differentiation of Instruction

The instruction was differentiated for students who were at a different skill level. For instance, highly skilled students were encouraged to perform a normal military style push-up and complete a great number of repetitions within a set, while we allowed students with low skills to perform push-up on their knees. When students were unable to perform the exercise correctly or needed additional assistance, we demonstrated in class while encouraging students to review online videos. Additional support was also provided to students who had limited technology access. These students were allowed to print and turn in a paper copy of their quizzes and/or exams responses.

Assessment of Student Learning

The students' health and fitness knowledge in the flipped course were assessed through various online multiple choice pretest and posttest quizzes and exams on constructs of *FitSmart* and exercise technique and anatomy. In addition, exercise rubrics were used to assess student acquisition and learning of the 13 exercises presented. The students had to demonstrate their skills in these exercises prior, midway, and at the end of the unit. To assess the students PA level in the class, students were given pedometers to wear for two weeks during class that measured their step count, activity time, and moderate to vigorous PA level. The evaluations were the same between the flipped and non-flipped courses.

Lessons Learned

The Instructional Experience

The flipped course was a great success. While it was relatively time consuming to prepare the materials in advance, it was very advantageous to create engaging and individualized classroom environments. Based on the course evaluation survey data, we found that incorporating specific strategies, such as learning assessments and activities after each topic covered, is necessary to successfully flip a PEA course.

Reducing lessons to two times per week motivated students to review instructional videos in advance. We also learned that the online content should be interactive and challenging (e.g., containing quizzes and games) and be on a user-friendly and easily accessible platform to keep students engaged outside of the classroom.

The Student Experience

The students pinpointed several strengths of the flipped course including getting more PA during a class, student autonomy, and engaging class activities. The online videos about how to perform the various exercises provided students with ample time to practice and to meet their 30–60 min of PA requirement per day. The students also indicated that they enjoyed the autonomy given for them to exercise on their own, the personalized attention they received when they encountered challenges in performing exercises and meeting goals, and how the videos helped them think critically about what they were doing incorrectly. With the content presented online, we noticed a shift in students' learning and behavior. They became more interactive, engaged, and enthusiastic about their activities in the classroom. Their log sheets of outside PA also evolved into higher intensity activities and showed that they exercised with a family member, friend, or group. Although students were quite satisfied with the overall class structure, they made several recommendations. They suggested utilizing shorter instructional videos. The videos we used lasted approximately 10–12 min which students indicated were too lengthy and contained excessive information. The low skilled students suggested having a pre-flipped phase to allow students a few weeks to acclimatize to fundamental exercise skills before implementing the approach.

References

Allen, M. W. (2003). *Guide to e-learning: Building interactive, fun, and effective learning programs for any company*. Hoboken, NJ: John Wiley & Sons.

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development, 50*(3), 43–59.

Merrill, M. D. (2008). Converting e_3-learning to e^3-learning: An alternative instructional design method. In S. Carliner & P. Shank (Eds.), *The e-Learning handbook: A comprehensive guide to online learning* (pp. 359–400). San Francisco, CA: Pfeiffer.

Merrill, M. D. (2009). Finding e^3 (effective, efficient and engaging) instruction. *Educational Technology, 49*(3), 15–26.

Jafari, Z. (2014). A comparison of conventional lecture and team-based learning methods in terms of student learning and teaching satisfaction. *Medical Journal of the Islamic Republic of Iran, 28*, 5.

Michaelen, L., Parmelee, D., McMahon, K., & Levine, R. (2008). *Team-based learning for health professions education*. Sterling, VA: Stylus.

Blouin, R. A., Riffee, W. H., Robinson, E. T., Beck, D. E., Green, C., Joyner, P. U., & Pollack, G. M. (2009). Roles of innovation in education delivery. *American Journal of Pharmaceutical Education*, *73*(8), 154.

Crouch, M. A. (2009). An advanced cardiovascular pharmacotherapy course blending online and face-to-face instruction. *American Journal of Pharmaceutical Education, 73*(3), 51.

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education, 31*(1), 30–43.

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist, 25*(1), 3–17.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. New York, NY: Prentice Hall.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Upper Saddle River, NJ: Prentice-Hall.

Lents, N. H., & Cifuentes, O. E. (2009). Web-based learning enhancements: Video lectures through voice-over PowerPoint in a majors-level biology course. *Journal of College Science Teaching, 39*(2), 38–46.

Day, J. A., & Foley, J. D. (2006). Evaluating a web lecture intervention in a human–computer interaction course. *Education, IEEE Transactions on, 49*(4), 420–431.

Flipping Other Areas

Abstract This chapter contains case studies from nontraditional content areas. Three case studies showcasing a flipped approach in three vastly different subject areas all emphasize a collaborative approach to problem solving. Like several of the case studies previously mentioned, these cases operate in a constructivist, student-centered environment. In-class activities replicate the workings of real-world settings and instructors use Gagne's nine events of instruction theory to design and develop collaborative out of and in-class activities. Each case study opens with the instructional context and a rationale for flipping the classroom. The case-study authors also describe the structure of the course, as well as descriptions about how they prepared their students for flipping, and an evaluation of the flipping experience from both the instructor and student perspectives.

A Case Study on Legal Research and Writing

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Instructional Context

Course Name and Description

I teach Legal Research and Writing ("LRW") courses—four credit hours split between fall and spring semesters of the first year of law school. LRW courses introduce law students to legal research and writing methodology/techniques necessary for law practice.

L. Santos Green et al. (eds.), *The Flipped College Classroom*,
Educational Communications and Technology: Issues and Innovations,
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Place of Course in Larger Program of Study

The Mizzou Law JD is an 89 credit-hour program. The first-year required curriculum includes Contracts, Civil Procedure, Torts, Property, Criminal Law, LRW, and Lawyering.

Learning Goals of the Course

I strive to introduce students to legal research methodology, legal citation style, and formal legal writing. The first semester assignments are three objective memoranda, one e-mail memorandum, and a midterm examination. In the second semester, students research/draft pleadings, a summary judgment motion, and an appellate brief. Students also participate in two oral arguments—at the trial and appellate court levels.

Description of the Learners

The Mizzou Law first-year class has approximately 115 students, with 39 % women and 17 % minority students. I teach two of six first-year LRW sections. The LRW methodology/techniques used in the practice of law are unique from academic research, writing, or citation; first-year law students are learning these skills for the first time.

Rationale for Flipping

I flip my LRW courses because I believe that students should be actively involved in the process of learning and I should serve as a facilitator and guide. I position this active learning during class meetings to devote class time to what I value pedagogically. Passive learning is moved outside of class meeting time. Thus, there is less in-class lecturing and more class discussion and opportunities for students to work. Students can make mistakes in a safe and nonjudgmental environment. Class meetings are spent engaging, analyzing, evaluating, and creating.

Model (s) and Theory (ies) Used to Guide the Flipping

I utilize a constructivist theory in my flipped courses. I endeavor to engage students with materials and content so they can create and construct their own knowledge, systems, and understandings. This correlates with a student-centered, rather than a teacher-centered, approach. Also, I use a collaborative model for all in-class activities.

Structure and Implementation

Structure of the Flipped Course

My LRW courses are structured like a simulated law firm, where students work collaboratively with other "firm attorneys" to research and write about legal problems. They watch screencasts ("conference calls") before class and arrive ready to participate in "real" law firm work. Twice each semester, I have formal "partner" meetings outside of class. These meetings occur after major assignments and last approximately 30–45 min. I act as the law firm partner and discuss and critique their research and writing process. My goals for the flipped class are to cover materials in more depth, engage more students, provide more differentiated learning, and achieve greater student responsibility for learning.

Preparation of Learners for Participating in Flipped Instruction

I devote the first class period to teaching students about my educational philosophy, including flipped learning pedagogy. I start by creating a class culture of support so that students will feel safe to take risks and make mistakes. Next, I talk about the process of learning-by-doing and how collaboration allows students to learn from each other. Finally, I explain that the flipped structure allows us to spend class meeting time collaboratively engaged in the real work of learning—critical thinking, analysis, synthesis, and generally the process of thinking like a lawyer.

Description of In-Class and Out-of-Class Activities

Class work is organized around instructional units. For each unit, I create objectives-based lesson plans, where I integrate different teaching methodologies to help students access the materials.

Prior to class meetings, students watch a five-to-ten min screencast covering a discrete lesson. The screencasts consist of a PowerPoint presentation, a voice-over, and visual annotations. For example, one screencast introduces students to the petition—a pleading that commences civil litigation. In the screencast, I first define what pleadings are, reinforcing students' Civil Procedure course and putting their assignment in context. Next, I talk about the purpose of a petition. Then, I introduce petition sections and align those sections with the governing procedural rules. I also show a sample petition to show the unique formatting and I introduce petition-specific legal terms. Finally, I offer practice tips. The screencasts are available until the end of the semester, and students regularly review them.

By flipping material onto screencasts watched before class, I have more class meeting time available. I use this extra time to create workshop style meetings. During the opening discussion, I orient the class towards the objectives and goals

for the day and elicit procedural and substantive discussion. This may take the form of questions and answers or facilitative discussion.

During the bulk of the class meeting, students are engaged in process-oriented activities that allow students to implement what they learned in the screencast, employing higher-order thinking skills when I am most available to guide their learning. For example, one of my screencasts gives students an introduction to a legal memorandum. In that screencast, I tell the students the various parts of the memorandum and provide some examples. With this information, students have a rudimentary understanding of the facts section. Then, in class, students draft, revise, and edit the statement of facts. Here, students have to engage in the process themselves. Because I am present when students are actively learning, I am able to give feedback while they are in their learning zone. I can ask students specific substantive and procedural questions. I can demonstrate how to evaluate which facts are legally and emotionally relevant.

At the end of class meetings, I encourage students to collaboratively synthesize the activity. For example, during a class about drafting a persuasive statement of facts, we discuss and list effective persuasive writing techniques at the end of class.

Tools Used to Support the Flipped Process and Learners

I use PowerPoint for my presenter software and Explain Everything (an iPad app) for my screen capture software. Explain Everything allows me to import PowerPoint slides, record voice-overs, and annotate. It also allows for slide-by-slide editing of audio and visual components. I post the screencasts for the students on TWEN, an electronic learning management system.

Differentiation of Instruction

All Mizzou Law LRW sections have uniform assignment requirements; thus I cannot differentiate the product that students turn in. Yet the process of flipping the classroom allows for some differentiation of instruction. In contrast with an in-class lecture, students can watch the screencasts at their own pace, stopping and repeating as needed. The screencasts remain available to students throughout the semester so students can access material when they are ready for it.

I also differentiate the learning environment. I individualize in-class activities based on students' needs. For example, during class I may conference with some students who are adept at finding a specific statute; for those students I expand the basic assignment and have them research multiple statutes in various jurisdictions, and I leave them with a specific goal of creating a log of statutory variations. Other students may not be as proficient, and so I conference with them about three specific research strategies. I leave those students with a specific goal of evaluating research strategies using specific criteria. I also conference individually with students providing oral critiques of their writing, a sounding board for their progress, or research assistance.

Assessment of Student Learning

All LRW sections are assessed using the same assessment model, the same grading rubric, and a mandated final grade mean. The final grade consists of a memo or brief grade (75 %), participation (10 %), and a combination of research grades, grammar grades, and citation grades (15 %, combined). The rest of the assignments are graded on a pass/fail basis. There is no separate accountability scheme for watching screencasts; yet I have emphasized their importance as part of the learning process and compliance has not been an issue.

Lessons Learned

The Instructional Experience

I have flipped my LRW courses for three semesters and each semester has been more successful than the last. Planning process-oriented classroom activities has been the easier part for me. I derive many of these activities from my practice as a lawyer and I enjoy facilitating student engagement with various methods and materials. Determining what content is appropriate for a screencast and distilling that content into short sound bites is harder than I anticipated. I have found that it is better to have multiple shorter screencasts than longer screencasts that cover several concepts.

Practically, it surprisingly seems better that students do not have access to the screencasts until the content is relevant to the class. Instead, I provide screencasts when they are pertinent and then students have continued access for the remainder of the semester. When provided with universal access at the beginning of the semester, students actually watched less and came to class less ready to participate.

The Student Experience

Each semester, I collect formal and informal feedback from students, through end-of-semester student ratings, guided written feedback, class discussion, and unprompted e-mails.

Student feedback has been uniformly positive. In a representative e-mail, one student stated, “I felt the [screencasts] were a great way to present the material. I liked being able to go at my own pace, because it takes me longer than most to absorb information … It helped me a ton to have time in class to actually implement the information, because that is when I had questions (and those questions were often very quick ones I may have just glossed over if you weren't right there).” My overall student ratings have increased as well.

I have also observed an overall shift in the quality of student work and attitude. Students show a greater appreciation for the writing and learning process. And

many students show an increased appreciation of learning practical skills, rather than only focusing on grades. I see this change in improved quality of student work on pass/fail assignments and student enthusiasm for class participation.

A Case Study on Microeconomics

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Instructional Context

Course Name and Description

Principles of Microeconomics is an introductory course that exposes students to the economic way of thinking. It teaches the fundamentals of microeconomics and applies these principles to address problems in current economic policy.

Place of Course in Larger Program of Study

This course is required for all undergraduates in the School of Business seeking a concentration in Economics. It is also a general education option for students seeking a Bachelor of Business Administration degree.

Learning Goals of the Course

Microeconomics deals with the individual parts of the economy such as businesses, industries, consumers or households, goods and services. Upon completion of the course, students develop an ability to think critically and analytically about economic forces at work in society. Knowledge gained in the course will help students become better-informed citizens who are able to apply tools learned to strengthen their discussion of and appreciation for the different economic events and policies reported in the news media.

Students who complete this course are able to:

- articulate basic terminology of microeconomics;
- use graphs of economic relationships as tools for economic analysis;

- apply analytical tools of supply and demand to predict results of changes in economic conditions and policies;
- analyze consumer and firm behavior;
- compare and contrast market outcomes under different market structures;
- evaluate the outcome of controversial social issues and economic policies

Description of the Learners

Majority of the learners (80 %) are traditional students (18–22 years old). Freshmen and juniors/seniors are 34 % and 32 % respectively, while male students make up 54 %. Majority of the students have no prior background in economics, and for many students, we find that economics is a difficult subject to understand.

Rationale for Flipping

We flipped the course because we wanted to use class time more effectively. We wanted class time to be more hands-on for practicing problems with peers. We believe in student-centered learning and want students to take ownership of their learning. Economics deals with everyday life, decision-making and other social and economic issues, and the course lends itself to debate and discussion. Flipping allows more time to gain a deeper understanding of the material, discuss real world issues together in class, and practice concepts learned under instructor supervision. Finally, flipping supports the university's mission to emphasize innovative use of educational technology to enhance learning.

Model (s) and Theory (ies) Used to Guide the Flipping

We used Gagne's nine events of instruction theory to design the course (Gagné, 1985). Gagne's at-home events of instruction include activities such as an introductory question to help students think about the unit objectives, connect current material to prior experience, and gain their attention. At-home events of instruction also include watching instructional videos to give students a foundation of the material. Gagne's in-class events of instruction include providing guidance and feedback within peer groups as the groups work towards understanding the material, providing new insights into the problems, and assessing performance through quizzes.

Interactive classroom activities foster student-centered learning and justify the design/selection of the in-class learning activities. We used peer instruction techniques to structure in-class activities, which involved small group collaboration.

Structure and Implementation

Structure of the Flipped Course

The class uses before, during, and after-class activities. Before class, students receive first exposure to the material by watching one or two short instructional videos, reading an assigned chapter, and completing pre-class work (PCW). During the 75-min class period held twice a week, students practice solving problem sets on key concepts in collaboration with their peers. The instructor provides on-the-spot feedback. Towards the end of each class, students confirm their understanding of the material through reviews and tests.

Preparation of Learners for Participating in Flipped Instruction

Most students are familiar with traditional lecture-style teaching, and we expect the flipped class to be new and challenging to them. We explain the format and expectations of the course to students at the beginning and throughout the semester. We provide frequent reminders to students via texts, e-mails, and in-class announcements about the importance of accessing out-of-class materials and completing PCW prior to class. We modified a test preparation checklist (Felder, 1999) and administer it to students before the first test as a prompt of things they need to do to succeed in the course (Appendix 1).

Description of In-Class and Out-of-Class Activities

Out-of-class activities: Before each class, students are assigned Read/Listen/Review (RLR) activities to prepare for class day. Students have to read one textbook chapter, watch one or two short videos, and review PPT slides. Then they are assigned a Pre-Class Work (PCW) to submit before class. PCW is a critical piece of the flipped classroom given to students to demonstrate understanding of some baseline knowledge before class. PCW consists of guided questions, simple calculations, or very short essays.

In-class activities:

During each class, time is structured as follows—

(a) (~eight min) Students take a four-multiple choice question (MCQ) pre-quiz. These quizzes are taken on their mobile devices using www.socrative.com and results immediately available to the instructor. Descriptive statistics of the MCQs are discussed (e.g., average pre-quiz grade = 64 %; Question #two posed a challenge, etc.) but we do not reveal the correct responses yet.
(b) (~10 min) Based on PCW submissions and pre-quiz grade results, we give a brief overview of the concepts, clarify misconceptions, and answer any questions.

(c) (~40 min) We distribute an in-class activity handout, demonstrate how to work through some assigned problems, then we allow students to work through other similar problems in groups using peer instruction. While students complete the handout, we move around the classroom interacting with them, listening to their discussions and providing guidance. We may show a short documentary or news piece followed by class discussion to connect the concepts to real-life applications. The in-class activities are drawn from the Internet, or textbook publisher website.
(d) (~five min) Next, we debrief the concepts, put them in context, and wrap up the chapter.
(e) (~five min) Students take the same or similar MCQ Post-Quiz. They are now allowed to confer with group members and change their answers. This time, answers are revealed and overall quiz grade is publicized. Students are able to note the difference between their pre- and post-quiz grades.
(f) (~seven min) The remaining time is for Q&A.

Tools Used to Support the Flipped Process and Learners

Videos were created using Echo 360 for recording instructional videos, Bamboo Tablet which allows us to add hand-written notes, sketches or drawings on the screen with a digital stylus, SnowBall Microphone, used for sound, and PowerPoint slides containing the content for instruction. Students use their personal mobile devices to complete quizzes on socrative.com. Another tool used to support the flipped process was www.remind.com. We used it to stay connected to the students by sending instant text messages about assignments that were due, as well as notes of encouragement. The Learning Management System used, BrightSpace, was where all content videos, PCW, grades, announcements, dropboxes, and calendar of upcoming events were posted.

Differentiation of Instruction

Table 1 exemplifies how the class was changed from the traditional classroom style in Spring 2014 to a flipped classroom model in Fall 2014 and then improved in Spring 2015. In Spring 2015, we reviewed students' login activities in BrightSpace and sent individual e-mails to those who did poorly on the quizzes if they were consistently not logging in for out-of-class activities, further providing individualized instruction.

Assessment of Student Learning

We assessed student learning with five tests, dropping their lowest grade. Tests were 80 % of the final grade. Each test consisted of multiple choice and short answer questions. Post-quizzes made up 20 % of final grade. PCW comprised a 10 % bonus.

Table 1 Differentiation of instruction and assessment of student learning

Spring 2014		Fall 2014		Spring 2015	
Instruction:					
Traditional Classroom		Flipped Classroom			
• Lecture-style		• Read/Listen/Review			
• PPTs in Class		• In-Class Activities			
• In-Class Discussions					
Assessments:					
• Quizzes	10 %	• Four Tests	80 %	• Five Tests (one dropped)	80 %
• Article Summary	15 %	• Pre/Post Quiz	20 %	• Post Quiz	20 %
• Three Tests	45 %			• Pre-Class Work (bonus)	10 %
• Final Exam	30 %				

Lessons Learned

The Instructional Experience

As the semester progressed, we observed students coming to class more prepared. We also noticed peer instruction helping forge relationships among the students. Compared to traditional teaching during class time, flipping allowed for more in-depth coverage of the material in class and gave us the ability to conduct more assessments. Our role in the classroom changed from being sage-on-the-stage to guide-on-the-side and going to class became more stimulating and enjoyable.

One key component of the course was the PCW assignment. The first time flipping the course, there was no graded PCW component. Adding PCW greatly increased the level of students' out-of-class preparation. In the future, PCW assignments will be a major component of the course grading scheme, not just a bonus, to motivate students to complete these before class and come more prepared.

The Student Experience

Exit survey results showed that majority of students had positive experiences with the various components of the flipped classroom. Students found taking their in-class quizzes on their mobile devices easy, with over 70 % agreeing that it increased their desire to come to class, recommending its use in other classes. When asked what students liked most about preparing ahead of class, over 80 % appreciated the advance preparation requirement. Students stated that "*I was ready every single class of the semester even before I came in*" "*The videos are extremely convenient to listen to before class*" and advance preparation "*… helps you retain information the professor expands on that day.*" As with any teaching innovation that deviates from the traditional style, there will be students who do not adapt well to it. Negative exit survey responses were more about personal circumstances of the students than with the flipped model. One comment was *"I don't like it because I have a full time job."*

Since the bulk of instruction was done outside of class, it freed up class time for more student-to-student interaction, which students enjoyed. Feedback from students stated that the class "*Worked well. Got help from classmates and then teacher when needed.*" "*… having time to work on questions with peers was great.*" "*Groups help because if I don't grasp a concept immediately, one of my peers may have a better understanding and can help teach me in other ways.*"

A Case Study on Vocabulary Acquisition for ESL Students

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Instructional Context

Course Name and Description

Level One Vocabulary and Literacy is a course for students with low English proficiency. Students at this level only know past and present tenses in English and can write simple, often grammatically incorrect sentences. There are 484 words on the required vocabulary list. The learning outcomes require students to know the meaning, grammatical form(s), how to spell, pronounce, and use all the words on that list. In addition, students have to learn to hear and produce all 15 vowel sounds in American English and all 24 different consonant sounds. To do this, the curriculum requires the use of the International Phonetic Alphabet (IPA).

Place of Course in Larger Program of Study

The intensive English Institute (IEI) at Ball State University is an academic English training ground for international students. There are seven levels in the program from fundamental (zero), to being ready to study at the university, level six. The curriculum is designed so that students have six different skill courses in each level, and the cohort of teachers working with each group of student collaborates to reinforce skills across the curriculum. The Level One Vocabulary and Literacy course is placed early in the program as it aims to increase students' vocabulary and teach them to understand nuances in meaning for different words. It is also important to note that each session is only seven weeks long. The curriculum is designed to move very quickly.

Learning Goals of the Course

The academic cultures in the home countries of the students vary greatly from American academic standards and expectations. Many international students are not familiar with some of the concepts Americans believe are normal expectations in higher education such as doing homework, coming to class on time, being independently resourceful, taking responsibility for learning, and group work. Therefore, in addition to the learning outcomes for each course in our program, teachers also have the additional goal to help acculturate the students to become successful in an American classroom. Teachers in the program are free to address these goals in individual ways. I chose to flip the course because I believed the flipped model would become the impetus to get students to actively participate in some of these expected behaviors. In particular, I wanted them to embrace their role as learners and begin to use their time outside of class more effectively.

Description of the Learners

The population of the IEI program at BSU is primarily from China and Saudi Arabia. When I taught the course and flipped it, 90 % were Arabic speakers and the other students were Chinese speakers.

Rationale for Flipping

I taught this course seven times using traditional methods. I read about flipped models in science and math courses, but never in an ESL course. What attracted me to the flipped model was the idea that students could do what was normally considered to be "homework" in the classroom where I could observe the process of application and be on hand to answer questions as they arose. I was frustrated by the amount of time it took to teach the IPA and the meanings of the vocabulary words. Despite the time dedicated, students still weren't able to apply what they learned to anything other than the examples used in class. I decided to flip the *Level One Vocabulary and Literacy* course because I felt students were not sufficiently mastering the course outcomes and seven weeks was not enough time to accomplish all that I wanted to do. Based on what I knew about flipping, I believed it would allow me to use class time more efficiently. My vision for flipping was that students would learn the meaning of new vocabulary and the IPA outside of class so we could use class time applying that knowledge to new situations.

Model (s) and Theory (ies) Used to Guide the Flipping

In preparing to flip the course, I read many articles and case studies about flipping courses at the university level. Those that served as my model were Math and Physics courses. I chose to follow these models by making the bulk of learning new

material take place outside of the classroom via videos of me teaching as I had previously done in the classroom. Then I designed in-class activities so that students could solve problems with that new knowledge with me there for assistance. These in-class activities were based on homework assignments I had used when I taught the course before flipping, but redesigned to incorporate group work with an emphasis on solving problems.

Structure and Implementation

Structure of the Flipped Course

Keeping to the most basic definition of the flipped classroom model, I set about creating videos of myself teaching what I had normally taught in the classroom. I used two formats: (1) PowerPoint presentations with voice, and (2) videos using only my iPad and iMovie on my Mac computer. I then made a YouTube channel and put the videos there for my students to access. Each video was less than 10 min long. Students were required to watch the videos before attending class. I made this clear by having all students keep a "Task Record" where each day they wrote their learning goals for the next class meeting.

Preparation of Learners for Participating in Flipped Instruction

My next challenge was to get students to actually watch the videos before class. On the first day, I told the students that their experience in my classroom would be different from anything they had experienced before. This created a sense of curiosity. Then I asked them to trust me, further pushing the curiosity. On the first day, I conducted a scavenger hunt in the classroom with students finding hidden words that, when put together, created the main points of the syllabus. These components demonstrated to the students that active participation would be required of them. They enjoyed the activity so it was easy to stress that if they didn't watch the assigned videos before class, moving forward, they would not be able to participate in future activities.

Thereafter, at the beginning of class, I gave a short quiz on the materials students should have viewed at home. The first one was based on homework assigned on the first day of class. It was somewhat of a disaster because many students hadn't done the homework, as I expected. However, I was strict in not giving them a chance to make up the quiz another time. I was also committed to forging ahead with the few students who were prepared. Those who hadn't done the homework were affected not only by losing points, but also because they couldn't effectively participate in the class activity. I designed the activity to be fun and to be completely dependent on the information in the previous homework. Those who were not prepared felt the effects of not doing their homework without any reprimand or punishment from me. This was the first "lesson" in becoming responsible for one's learning. Students got

the flipped idea almost immediately after that because they wanted to be able to do the class activities and they wanted those points on the quizzes. This set the stage for the flipped model over the course of the seven-week session.

Description of In-Class and Out-of-Class Activities

Traditionally, I spent class time explaining new vocabulary words and giving them examples of the words in different contexts. Or, with the IPA, I explained each sound and symbol in class. When I flipped the course, all this information was provided for students via videos and assigned as work to be done prior to class meeting times. A quick quiz at the beginning of class might be to transcribe a few words written in the IPA and spell them correctly and then choose the best one for a given definition. Then, during the class sessions, we categorized the vocabulary into groups with similar meanings, similar word forms, same vowel sounds, etc. Another type of class activity was for students to work in groups to identify the best word for given situations. Afterwards, they created their own contexts and produced their own sentences, sharing these with their classmates. Structuring the course in this way allowed me to address several learning outcomes, overlap the outcomes and reinforce these many times throughout the course.

Tools Used to Support the Flipped Process and Learners

The tools I used to prepare my videos were my Mac computer, the iMovie program, and YouTube for video hosting. In class, we used small, portable white boards so that students could visually brainstorm, draw ideas and images, create their categories, and sentences. With these boards, students could work in a group at one board, then move to other boards to contribute to the work of other groups. We could also easily see the work in process and this led to meaningful discussions.

Differentiation of Instruction

By flipping the course, I was able to double the amount of exposure the students had to the course material, as well as provide many reinforcement activities to help them better learn the material. My role changed as I became more of a facilitator in their learning. Throughout the duration of the course, students first learned new information at home via videos. Class time was spent solving problems through team activities. For example, after learning the IPA, an in-class activity would be to categorize words by their vowel sounds. Or, after learning spelling rules, students would classify words under each rule and identify exceptions. An exam could then be to apply what they learned about sounds and spelling rules to new words.

Before flipping this course, nearly all my in-class time was spent teaching and explaining concepts, and tests were focused on students' ability to memorize

examples presented in class. After flipping, there was much more emphasis on application during class meetings.

Assessment of Student Learning

Assessments measured students' ability to connect what they learned in order to explain or solve new problems. After flipping this course, my initial assessment was based on the level of student engagement in the learning process and hence, their acceptance of responsibility for their own learning. In future sessions, I would like to compare exam grades between a class taught traditionally and one taught following the flipped model.

Lessons Learned

The Instructional Experience

I think the key to the success of this flip was the transfer of responsibility for learning from me as the teacher, to the students. When students became responsible, not through lecture, but through their involvement with the lessons, then true learning took place. Students moved beyond rote memorization to being able to figure things out for themselves. This ability should help them in future classes and situations where they will have more reasoning skills to approach problems.

The Student Experience

I believe that students enjoyed being able to do more challenging activities in class. This is evidenced by the fact that I saw them fully engaged. I also received considerably fewer complaints about the curriculum. Students asked more meaningful questions both inside and outside of the classroom. In particular, for the first time in my ESL career, more students came to class with specific questions about the material. This low level vocabulary and literacy course is very difficult for students, and historically, one that they have disliked and resisted. After flipping, student comments on course evaluations indicated that (1) they learned faster; and (2) hey enjoyed the class. I found that although it was more work for me initially to create the videos and structure new lessons that were based on collaboration and solving problems, the subsequent class work was significantly more meaningful, both for me and for the students.

Flipping an ESL course offers an opportunity for students to implicitly learn to be independent, resourceful, and cooperative and to take responsibility for their own learning. It offers teachers opportunities to do more follow-through activities and be more involved in guiding students through the process of applying and practicing new skills. I will definitely flip more classes in the future.

Appendix 1: Test Preparation Checklist

Answer "Yes" only if you ***usually*** do the things described (as opposed to occasionally or never).

Before Class Preparation and In-Class Participation

__Yes	__No	
		1. Do you **Read** the Textbook/**Listen** to the Videos/ **Review** the PPT Slides before class?
__Yes	__No	
		2. Do you work with classmates on Pre-Class Work, extra problems, or at least check your solutions with others?
__Yes	__No	
		3. Do you attempt to work through in-class problems/discussion questions on your own before working with classmates (as opposed to just waiting to copy the solution)?
__Yes	__No	
		4. Do you participate actively in group discussions (contributing ideas, asking questions)?
__Yes	__No	
		5. Do you consult with the instructor and ask for explanations as soon as possible when you are lost/need clarification?
__Yes	__No	
		6. Do you practice drawing the graphs and make the effort to understand them?
Test Preparation		
__Yes	__No	
		7. Do you carefully go through the Study Guide (with classmates and quiz one another) before the test and convince yourself that you can do everything on it?
__Yes	__No	
		8. Do you attend the Review Session right before the test and ask questions about anything you aren't sure about?
Finally,		
__Yes	__No	
		9. Do you plan to get a reasonable night's sleep before the test and allocate a block of time to take it when your mind is alert and without distraction? (If your answer is no, your answers to one to eight may not matter.)
__Yes	__No	***TOTAL***

The more "Yes" responses you recorded, the better your preparation for the test. If you recorded two or more "No" responses, think seriously about making some changes in how you prepare for the next test.

Do whatever it takes to be able to answer YES to most of the questions

Adapted from Felder (1999)

Reference

Gagné, R. (1985). *The conditions of learning and the theory of instruction* (4th ed.). New York, NY: Holt, Rinehart, and Winston.

Felder, R.M. (1999). Memo to students who are disappointed with their last test grade. *Chemical Engineering Education, 33*(2), 136–137.

Appendix A: Ten Instructional Strategies That Support the Flipped Classroom

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Activity 1: Academic Conversations

A strategy that includes a set of conversational skills teachers can use to support student engagement in extended discussion about various kinds of texts (Zwiers & Crawford, 2009).

Activity 2: Discussion Web

A strategy that encourages students to assume a greater share of the discussion after reading a common assigned text (Alverman, 1991).

Activity 3: Anticipation Guide

This advanced organizer serves as a scaffold to activate and assess prior knowledge and focus the reading task, supporting less involved students by encouraging interest in the topic (Dean, Hubbell, Pitler, & Stone, 2012).

Activity 4: Chapter Discussion Protocol

Designed to support discussion skills, this strategy helps students determine what is important to themselves as readers, to the smaller discussion group, as well as to a full class discussion (Dean & Parsley, 2008).

Activity 5: Concept Definition Map

The concept definition strategy is used to highlight salient material and concepts in a given reading through the use of graphic organizers and strategic questions (Schwartz, 1988).

L. Santos Green et al. (eds.), *The Flipped College Classroom*,
Educational Communications and Technology: Issues and Innovations,
DOI 10.1007/978-3-319-41855-1

Activity 6: Comparison Matrix

More comprehensive than a Venn diagram, the comparison matrix promotes a comparative approach to text analysis highlighting concepts and characteristics (Dean, Doty, & Quackenboss, 2005).

Activity 7: Final Word Protocol

Using rounds as a central feature, the final word protocol strategy allows all participants in a small group discussion to speak, listen, and respond (Urquhart & Frazee, 2012).

Activity 8: Problematic Situation

The problematic situation strategy motivates students to want to read more, helping readers to focus on main ideas in a text by highlighting a problematic situation (Vacca & Vacca, 2005).

Activity 9: QAR

The Questions-Answer Relationship (QAR) helps students construct four different kinds of questions (e.g., right there, think and search, author and you, and on my own) that result in deeper comprehension and knowledge about the inquiry process (Anthony & Raphael, 1989).

Activity 10: Think aloud & Text Coding

The Think Aloud strategy allows instructors to model important reading comprehension strategies by vocalizing the thinking process of a strong reader. When combined with text coding, it further supports active reading (Davey, 1983).

Appendix B: A Flipped Classroom Course Structure

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Designing a successful flipped classroom takes far more forethought than a regular, face-to-face course. When flipping a course, the instructor not only has to plan what will happen in the classroom, but also what students will do both before and after the classroom experience. I believe it's best to begin with planning what is to be done in the classroom. My top priority is to ensure that students remain engaged and focused on learning, throughout the class period.

Assignments before class must directly link to the in-class activities and give students the requisite background for active in-class participation. Knowing that what they are doing before class will help them be successful in class is a great motivator for students to complete the pre-class assignments. Likewise, the post-class assignments should link to what was done in class, so that students see the relevance of the material. This also serves as a way to extend the learning and build student confidence after the class. The model that I use is summarized graphically below:

L. Santos Green et al. (eds.), *The Flipped College Classroom*,
Educational Communications and Technology: Issues and Innovations,
DOI 10.1007/978-3-319-41855-1

Structure of a Flipped Classroom

	Inquiry	Collaborative
Before Class	Transfer of Knowledge	Individualized
During Class	Scaffolded Engagement	Collaborative
After Class	Reflection	Individualized

Before Class

I provide a variety of assignments for my students set up in two ways: collaborative and individualized. I use online polling and discussion boards to get students to view and collaboratively comment on material that will be discussed in class. The transfer of content knowledge is done individually by having students watch videos and screencastings, read the textbook, view PowerPoints, and complete a reading assignment (specific questions addressing the key topics that will be covered in class).

During Class

The face to face class contains a series of scaffolded, high engagement activities. This often starts with a demonstration or a simple conceptual problem where I provide as much support, encouragement, and direction as necessary to help build students' confidence. I might, for example, work out part of a problem and then let them complete it. This activity transitions into a problem-solving session where students work in small groups solving homework problems. They get support not only from their peers but from me as I continually work my way around the room checking in on each student and answering questions.

After Class

This is a time for celebration of newly found knowledge or insight. Students individually complete a post-class discussion activity where they describe, in their own words, the essential question for the class period, identifying any concepts that are still unclear. I also assign a challenge problem to build up their ability to complete a problem on their own.

Appendix C: An Example of a Course Structure Explanation Using Text

Betina Hsieh
California State University—Long Beach
Long Beach, CA, USA

The format for this course is "flipped." A flipped classroom is one in which you are introduced to content at home (through independent activities) then come to class for hands-on activities, practice and scenario-based experiences that reinforce this content. Flipped learning is a blended learning approach where face-to-face instruction is hands-on and can give you feedback on the applications of concepts that you will have been exposed to at home through video lectures, readings, supplementary materials prior to our face-to-face meeting each week. This means each week, you will be expected to access some online lecture materials and reading as well as engaging in a brief check-up activity before class. You will then come to class for hands-on and group based activities. After class, you'll be given the opportunity to revise your work before submitting your final assessment for the class. The structure of the class will be similar to this table:

L. Santos Green et al. (eds.), *The Flipped College Classroom*,
Educational Communications and Technology: Issues and Innovations,
DOI 10.1007/978-3-319-41855-1

Before Class you will:	In Class you will:	After Class you will:
• Read and take notes on assigned content • Watch and take notes on online lecture videos • Complete online check-up activities • Write down any questions you may have • Come to class prepared to participate	• Engage in scenario based activities • Hear from awesome real-world speakers • Work solo and in groups of two to four peers on activities • Collaborate with peers • Give & receive meaningful and constructive feedback to peers • Ask questions of peers or facilitators while in class	• Apply instructor feedback and peer recommendations to assignments • Finish assignments

For more info on how flipping will work in our classroom, please review the syllabus and contact me with any questions.

Appendix D: An Example of a Course Structure Explanation Using Audio

Brenda Ravenscroft
Queen's University, Kingston, ON, Canada

This is the transcription of an audio file that I made and posted on the course website together with a photograph, prior to the start of classes. The main goal of the message was to introduce students to the course structure. The transcription was posted as well to ensure accessibility.

This photograph of Elliott Carter and me was taken in Minneapolis in 2006. The composer was 97 at the time and I was less than half his age. We were in Minneapolis for a festival to celebrate his music; there were four days of performances, and I was part of a small group of Carter scholars who presented papers on his music in a symposium. I love this photo because I think it captures Carter's wit, his intelligence and his humor. I'd worked on Carter's music since my doctoral dissertation—and it was a thrill to have the opportunity to finally meet him.

So why was there a festival to celebrate Elliott Carter? Well, at that time he was probably the most famous and respected living composer of contemporary music, widely performed in both Europe and America. His status as a leading composer of the twentieth century lives on after his death in 2012—for a sense of how his music continues to flourish in both performances and publications take a look at the Elliott Carter website at *elliottcarter.com.*

This course is intended to be a journey of discovery into Carter's music, and I'd like to highlight three important aspects about the course structure that may be somewhat new to you.

First of all, the course is designed as a flipped model. This means that, instead of lectures in the class and homework at home on your own, much of the transmission of information will take place outside of the classroom so that class time can be focused on applying your knowledge, on active learning, on doing things, not just listening. Studies have shown that active learning is linked to deeper engagement

L. Santos Green et al. (eds.), *The Flipped College Classroom*,
Educational Communications and Technology: Issues and Innovations,
DOI 10.1007/978-3-319-41855-1

and better long-term learning outcomes. And you're going to be very active! You will have lots of tasks and assignments, both in class and out of class—all of which will be guided and all of which will contribute to your grade. So, while I may be very knowledgeable about Carter's music, I don't plan to be the sage on the stage, but rather a guide on the side, helping you to develop the tools that will allow you to make your own discoveries about the music. It's critically important that you come to every one of our 12 classes this term.

Secondly, the course includes a lot of group work. We're in one of the innovative active learning classrooms in Ellis Hall, specifically designed for collaborative work, and we're going to take full advantage of the room! A lot of your basic analytical work—the gathering of data—will be in groups, but the interpretation and writing of the analysis will be done as individuals. The group work will mean being responsible to your team, showing up, doing the work, contributing to the discussion, letting your group know if you're having challenges. On the other hand, the individual work has to be your own, and will mean adhering to the highest levels of academic integrity.

Thirdly and finally, the course website is an essential tool in this course. It's already filled with information and resources, and you'll use it weekly to both download and upload files. If that sounds scary, don't worry! Our first class will include an orientation around the site—you'll soon be Moodle pros. We'll also use the website for communication—there's a space for each group, a social space for general chat, and I'll send important announcements to you through the course news, which also goes to your Queen's e-mail address.

As I said earlier, this photograph of Carter was taken in 2006 when he was 97 years old. At that point, Carter hadn't even yet composed the piece we're going to analyze in this course; the song cycle *What are Years* was composed three years later in 2009, and three years after that he died at the age of 103. We are going to be the first people to analyze these songs, and I'm looking forward to embarking on this adventure into new territory with you.

Appendix E: An Example of a Learning Tasks Explanation for Course Syllabi

Monica Lamm
Iowa State University, Ames, IA, USA

Learning Task and Feedback Chart

Learning task					Feedback		
Activity	Time spent on activity (min)	Number of times per semester	Who participates?	Where is it completed?	What kind of feedback?	Who gives the feedback?	What is the purpose of the feedback?
Pre-class reading assignment	60	40	Individual	Out of class	Check your answers to the "Test Yourself" questions and worked example problems in the reading	Individual (you)	Check your conceptual understanding of assigned reading; check your problem-solving strategy
Solving the pre-class problem	120	34	Individual	Out of class	Score and comments on grading rubric	Grader	Offer guidance on your problem-solving strategy and execution
Note-taking during mini-lectures presented in class	10	40	Individual	In class	Worked example	Instructor	Check your problem solving strategy
Individual readiness assessments (quiz)	20	6	Individual	In class	Score	Grader	Check your conceptual understanding of current topic
Team readiness assessments (quiz)	20	6	Team	In class	Score	Instructor and teammates	Check conceptual understanding of current topic; compare your preparation and study habits to other students on your team and evaluate if you are spending enough time on the course
Writing appeals for missed questions on readiness assessment	10	6	Team	In class	Written response to explain the decision made based on your appeal	Instructor	Guidance on the use of technical concepts to construct and support an argument
Solving application exercises with team	40	34	Team	In class	Verbal input from instructor and teammates; Compare your team's answers and responses to others	Instructor, teammates, other students in class	Check your problem-solving strategy; compare your preparation and study habits to other students on your team and evaluate if you are spending enough time on the course
Concept checks (clickers)	10	16	Individual	In class	Score and verbal input from instructor	Instructor	Check your conceptual understanding of current topic
Study quizzes	30	12	Individual	Out of class	Score and written comments	Instructor	Check your conceptual understanding and problem-solving strategy for the topics covered during the week
Written comments from peers	30	2	Individual	Out of class	Written comments	Teammates	Evaluate your team skills to identify strengths and areas for improvement
Self reflection at mid-term	30	1	Individual	Out of class	Class responses summarized by instructor	Class	Comparison of study habits to the class norm
Exams	50	3	Individual	In class	Score and written comments	Instructor	What have you learned so far? What work still needs to be done by you to improve?

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Assignments and Evaluation Chart

Team-Based Learning	
This course uses the team-based learning instructional strategy and will likely be very different from instructional styles you have experienced before. Most of the content is covered individually with readings and short problems completed outside of class and most of the application activities, conventionally done as out-of-class homework and group projects, are done in teams during class. Teams will be assigned the first day of class and will remain together the whole semester. To ensure that all students complete the readings and are prepared to do the in-class application activities, readiness assessments (RAs) are taken by individuals and then by teams at the start of each module. The extent to which an individual and a team performs, determines course grades as decided by the class. Some descriptions of how team-based learning will be used in this course are given below. A table that summarizes the learning tasks you will be completing in this course and how each task supports the improvement of your problem-solving abilities and professional skills is provided on page nine.	
Assignments And Evaluation	
Individual Preparation (Pre-Apps)	Before most class meetings there will be an individual preparation assignment that calls for reading selected sections from the text, working selected example problems from the test, and solving a short Pre-App problem. Your solution to the Pre-App problem will be graded. Each preparation assignment will be posted on the Blackboard Learn course site. The posted class schedule lists the due dates for all the individual preparation assignments. You will be notified in class when changes are made to the assignment schedule. The Pre-App problem will be collected at the beginning of the class period on its due date. *If you are late to class, so is the Pre-App assignment.* Late assignments will be accepted until 4:00 pm on the due date. Late assignments will receive a maximum grade of 50 %. *Once an individual hands in two late assignments, no further late assignments will be accepted.* The solutions to the Pre-App problems will not be posted. You are responsible for learning how to solve the problems by getting help from the instructor before and/or after the assignment is due. Ask about the Pre-App problems in class or during office hours. To get the maximum benefit from the Pre-App problems, think carefully about how to solve the problems before getting help. Make an outline of how you would go about solving each problem. If you rely on the instructor or your classmates to "jump start" you on every Pre-App problem then you will have trouble with the exams. Your Pre-App problem solutions should be presented with a professional appearance. • Use engineering paper, begin each problem on a new page, use only one side of a page, and box the final answer. You can buy a pad of engineering paper at the ISU bookstore or online. • Write your name and the problem number at the top of each page. Staple the pages and fold them in half lengthwise (vertically). Write your name, the Pre-App problem number, and the date on the outside.

Readiness Assessment Quizzes (RA)	Each module will start with a readiness assessment. First, each person will take a short (10–15 min), multiple-choice RA quiz. The time allowed will be based on a "first third + five" basis: after the first third of the students submit the RA, all other students have five minutes to complete the RA. Students then retake the same RA as teams, using an instantaneous feedback assessment test (IF-AT) form; the same "first third + five" time rule will apply. Following completion of the team RA, teams can write appeals for questions they missed. The appeals must be based on either a disagreement with the question answer or question wording or a claim of ambiguous information in the readings. The instructor will review the appeals outside of class time and report the outcome of your team appeal at the next class meeting. Only teams are allowed to appeal questions (no individual appeals are considered).
Team Application Exercises (Apps)	You and your team use the foundational knowledge, acquired in the first two phases to make decisions that will be reported publically and subject to cross-team discussion/critique. Most of the time, your team will indicate a specific choice using a clicker (provided by the instructor). Often teams will be asked to report the rationale for their answer to the rest of the class.
Concept Checks (Clicker questions)	Most class periods will begin with a brief conceptual question to help you start thinking about the current topic. At the end of the class period, you will answer a few more conceptual questions to check your understanding of the current topic. All responses will be collected using clickers.
Study Quizzes	At the end of each non-exam week, a study quiz will be posted on Blackboard. The study quiz will have conceptual and problem-solving questions that are designed to help you check your understanding of the topics covered that week.
Exams	Three in-class exams and a final exam will be given. See the class schedule for specific dates. If you require exam accommodations, see me as soon as possible so that I can make the necessary arrangements. All examinations will be open-book, open-notes. Exams are taken by individual students. There are no team-based exams. If you miss an in-class exam without either prior instructor approval or a certified medical excuse, you may take a make-up exam at a designated time near the end of the semester. It will be fair but comprehensive (covering all the course material) and challenging. In-class exams missed with prior instructor approval or a certified medical excuse will be dealt with individually. If you miss the final exam without a valid excuse, a zero will be averaged into your grade.

Appendix F: An Example of a Learning Opportunities Chart

Barbara S. Spector
University of South Florida, Tampa, FL, USA

Cynthia Leard
Sustain-Ability Education

The chart below identifies learning opportunities in the flipped science methods classroom.

Where items are labeled "out of class" and "in class," the procedure is for students to complete the task outside of the classroom and present the resulting products in class. Classmates serve as the audience for the product, asking clarification questions, suggesting modifications orally in discussion during class, and sharing written notes with the presenter. The presenter is free to accept or reject the suggestions before submitting a final product for instructor grading.

When the product is an activity, such as the Internet visit, the presenter brings materials for the activity and directs members of his/her cooperative group (groups include four members) to do the activity. This is followed by a presentation describing the experience to the full class and open discussion stimulated by the instructor's initial debriefing questions.

L. Santos Green et al. (eds.), *The Flipped College Classroom*,
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The instructor uses what students have written in their weekly journals as the subject matter for inquiry and discussion at the beginning of most face-to-face classes.

Learning opportunity	Description	Purpose	Points (200 total)	Where enacted
One time				
Biography	Demographic Information Science Experiences	Facilitate Communication Establish a baseline of science knowledge and attitudes	5	Out of class
Internet visit	Select an internet hands-on minds-on activity-bring materials to class to do it with a group	Analyze activity for characteristics of elementary science teaching consistent with NSES	15	Out of class In class
Site exploration	With a group, explore a place in the community and tell how you would use this site with children	Make learning science and technology relevant Learn to use community resources	20	Out of class In class
Interview	Select someone you consider to be a scientist Interview him/her using your own open ended questions	Make learning science and technology relevant Provide access to community resources Create awareness of science careers	15	Out of class In class
Service learning project	Work in groups following the Earth Force format in the VRC	Contribute to resolving local real world issues while applying science	15	In of class
Final project	Design a science unit plan (minimum five days) for your future students using your site visit and, or, service learning project as cameos.	Understand how to design and carry out student centered inquiry based learning opportunities	20	Out of class In class
Multiple times				
Weekly journals	Indicate the data you are collecting and analyzing about science and teaching and learning throughout the course	Learn more about yourself Learn how to put thoughts into words Learn how to communicate-give and receive feedback Avenue for professional growth	35 (total for all journals)	Out of class

Learning opportunity	Description	Purpose	Points (200 total)	Where enacted
Self assessment (twice)	Complete a multi question assessment	Help you think about what you are learning Provide evidence of your learning	Course is incomplete without this task No points	Out of class
Professional disposition	Interactions in and out of class	Develop professional attitudes and dispositions	35	In class
Exams				
Quizzes	Unannounced 10 min tests, each with a different style question	Stimulate students to study text and VRC Provide discussion of various test taking strategies	20 (total)	In class
Mid term	Students contribute questions from which instructor builds the exam	Learn how to construct test questions that accomplish your goals	10	Out of class In class
Final	Students contribute questions from which instructor builds the exam	Give students ownership Enable students to vote to eliminate the test and add points to projects	10	Out of class In class

Appendix G: Examples of Weekly Overviews for a Flipped Class

Brenda Ravenscroft
Queen's University, Kingston, ON, Canada

Example One

Week One: 5–11 January

In the first week of this course you will become oriented to Elliott Carter's music and to the course goals and structure. You will become familiar with the song cycle *What are Years*, and will start to learn about the poet and the poems selected by Carter for his settings through a group assignment.

Learning Outcomes

On successful completion of this week's activities, you will be able to:

- Demonstrate an introductory level knowledge of Elliott Carter's music
- Navigate the course website
- Conduct research into poets and poems
- Prepare a group presentation

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In-Class Activities

As part of the introduction to the course you will engage in listening activities, and complete a survey. You will learn more about Elliott Carter's music by watching short videos. You will become oriented to the course goals and structure, and will practice using the course website. You will embark on a preliminary analysis of your song and the poem it sets.

Out-of-Class Activities

For Assignment #One (Group Poetry Presentation) you will learn about the life and poetry of Marianne Moore, as well as the specific poems set by Carter in the two songs we're focused on, *Like a Bulwark* and *That Being So-Called Human*. Each group will research their assigned topic and prepare a 15-min talk, to be presented orally in class using PowerPoint slides. Slides need to be submitted via Moodle by Sunday 11 January at 11:55 pm; presentations will take place in class on Monday 12 January at 6:30 pm.

You will also start to practice singing the vocal line of your song.

Readings and Viewings

- David Schiff, "Introduction" from *The Music of Elliott Carter*, 2nd ed. (Ithaca: Cornell University Press, 1998), 1–33.
- Steinberg, George, *Elliott Carter's Official Website*, The Amphion Foundation, Inc., 2014.
- Elliott Carter, *Carter on Carter: Early Years*, Boosey and Hawkes, 2010 (video).
- Elliott Carter, *Carter on Carter: Poets and Composers*, Boosey and Hawkes, 2010 (video).

Example Two

Week Six: 9–15 February

In the sixth week of this course we transition from pitch to rhythm. You will extend your pitch analysis in response to the feedback you receive, and use this pitch data to write an analytical paragraph. You will also read an article about rhythmic organization in Carter's music.

Learning Outcomes

On successful completion of this week's activities, you will be able to:

- Write in a music analytical style incorporating annotated musical examples.
- Identify the most important ways in which Carter organizes rhythm.
- Analyze rhythmic features in Carter's music using appropriate technical approaches.

In-Class Activities

After receiving feedback to your Group Pitch Analysis Summary (Assignment #Two), you will extend and finalize your group analysis. Then, as individuals, you will start writing a paragraph about a particular pitch feature in your song, following the guidelines for Individual Pitch Analysis Paragraph (Assignment #Three).

In this class you will also evaluate your peers and yourself in terms of group participation. This phase is formative—to give you feedback on how you are doing. But this information will be important for the peer evaluation exercise at the end of term when you will be asked to reflect on your contribution in light of the mid-term feedback. A 10 % grade for peer and self-evaluation will be assigned at the second, summative phase.

Our Health Break will be led by Group A

Out-of-Class Activities

You have an additional four days after class to finalize your Individual Pitch Analysis Paragraph (Assignment #Three) and submit it via Moodle—by Friday 13 February at 11:55 pm.

In preparation for Test #Two, which will take place in the class following the Reading Week break (Monday 23 February), you will read Jonathan Bernard's article on rhythmic organization in Carter's music and practice analyzing similar rhythmic features. Guidelines on how to read this article and how to prepare can be found in the document about Test #Two.

Readings and Viewings

- Jonathan Bernard, "The Evolution of Elliott Carter's Rhythmic Practice," *Perspectives of New Music* Vol. 26, No. 2 (Summer 1988): 164–203.
- David Schiff, "Technical Glossary" from *The Music of Elliott Carter*, 2nd ed. (Ithaca: Cornell University Press, 1998), 34–50.
- *What are Years*: https://www.youtube.com/watch?v=ZtxE9Q_ie2k

Example Three

Week Eight: 2–8 March

In the eighth week of this course you will demonstrate your understanding of Carter's rhythmic techniques through your group composition, as well as going deeper into your analysis of rhythmic organization in your song, and starting to summarize the data you have gathered.

Learning Outcomes

On successful completion of this week's activities, you will be able to:

- Explain and perform music with complex rhythmic structure
- Identify many details and patterns of rhythmic organization in your song
- Determine the importance of different rhythmic organization features

In-Class activities

Live music! Each group will present their Group Percussion Composition, first explaining it to the class and then performing it. The remainder of the class will be devoted to group analysis of rhythmic organization in your song. By the end of the class the majority of the analysis should be complete. Remember to consult the rhythmic analysis document introduced in week seven.

Our Health Break will be led by Group B

Out-of-Class Activities

You will analyze rhythmic organization in your song further, and prepare a written summary to bring to class and share with your group at the next class so that your group can assemble their Group Rhythmic Analysis Summary (Assignment #Five). Groups can decide how to divide the summary work between members. Each group member must bring their summary to class in a form (e.g., photocopies) that can easily be shared with their team.

Readings and Viewings

What are Years: https://www.youtube.com/watch?v=ZtxE9Q_ie2k

Appendix H: An Example of Feedback and Student Self-Reflection Sheets

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Fundamentals of Digital Imaging / Foundations of Computer Graphics

Design Review: Project 4

Reflection and Feedback Sheet

Name: _____ Date: _____

Student is able to: (Rank from 1 to 5) 1=Lowest, 5=Highest

Compose digital images that have an adequate format, color space and resolution	
Generate and communicate new ideas formulating them into effective visual concepts	
Combine typography, images, colors and other elements to create organized visual relationships	
Manipulate images and digital tools to create well crafted shapes (symbols and/or icons)	

Project strengths

Project weaknesses

How would you improve this project?

Reflection & Self-assesment

Project 4

In this project, I was able to:

Generate and communicate new ideas formulating them into effective visual concepts ☐

Combine typography, images, colors and other elements to create organized visual relationships ☐

Manipulate images and digital tools to create well crafted shapes (symbols and/or icons) ☐

Project strengths

Project weaknesses

What do you think was your biggest struggle in creating this project?

What strategies will I use to improve my design? (Be very specific)

Date of projected re-submission _____

References for Suggested Strategies

Alverman, D. E. (1991). The discussion web: A graphic aid for learning across the curriculum. *The Reading Teacher, 45*(2), 92–99.

Anthony, H. M., & Raphael, T. E. (1989). Using questioning strategies to promote active comprehension of content area material. In D. Lapp, J. Flood, & N. Farnan (Eds.), *Content area reading and learning: Instructional strategies* (pp. 307–322). Englewood Cliffs, NJ: Prentice-Hall.

Davey, B. (1983). Think aloud: Modeling the cognitive processes of reading comprehension. *Journal of Reading, 27*(1), 44–47.

Dean, C., & Parsley, D. (2008). *Chapter protocol. Success in sight: Module 3.2*. Denver, CO: McREL.

Dean, C. B., Doty, J. K., & Quackenboss, S. A. (2005). *Research into practice series: Classroom instruction that works*. Aurora, CO: McREL.

Dean, C. B., Hubbell, E. R., Pitler, H., & Stone, B. (2012). *Classroom instruction that works: Research based strategies for increasing student achievement* (2nd ed.). Alexandria, VA: ASCD.

Schwartz, R. (1988). Learning to learn vocabulary in content area textbooks. *Journal of Reading, 32*, 108–117.

Urquhart, V., & Frazee, D. (2012). *Teaching reading and writing in the content areas: If not me, then who?* (3rd ed.). Alexandria, VA: ASCD. ISBN 978-1-4166-1421-0.

Vacca, R. T., & Vacca, J. L. (2005). *Content area reading: Literacy and learning across the curriculum* (8th ed.). Boston, MA: Allyn & Bacon.

Zwiers, J., & Crawford, M. (2009). How to start academic conversations. *Educational Leadership, 66*(7), 70–73.

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